

July 1990/\$3.00

# Mobile Radio Technology

The journal of mobile communications technology



Capacitive bottom-loading, p. 10

If it's not a whip...

Analog scrambling

Curing RF interception

Product/Services Showcase



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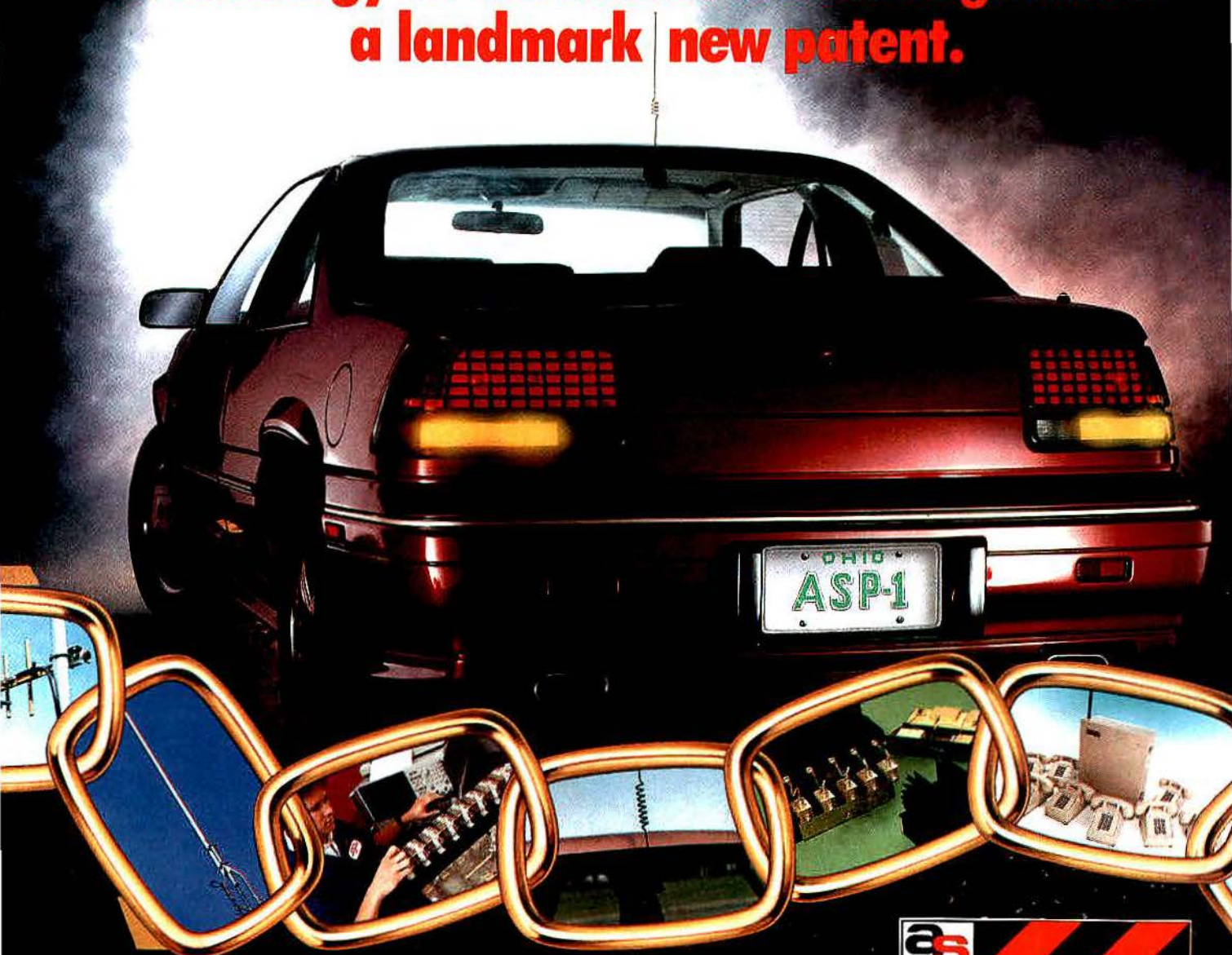
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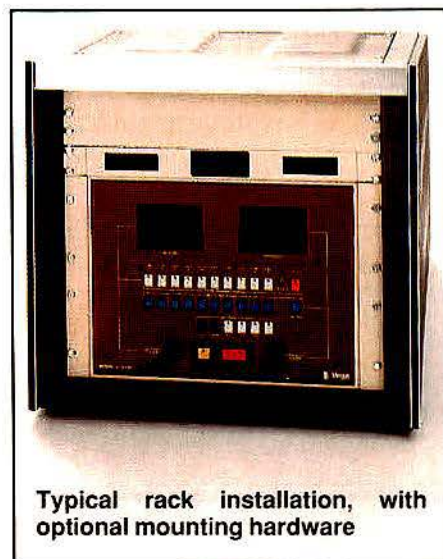


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## features

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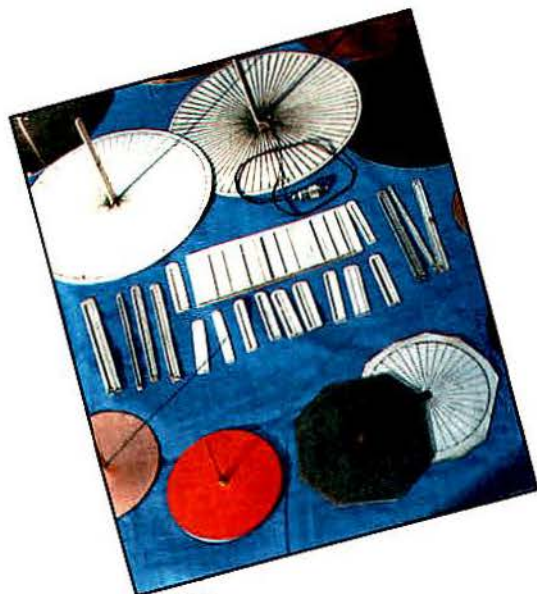
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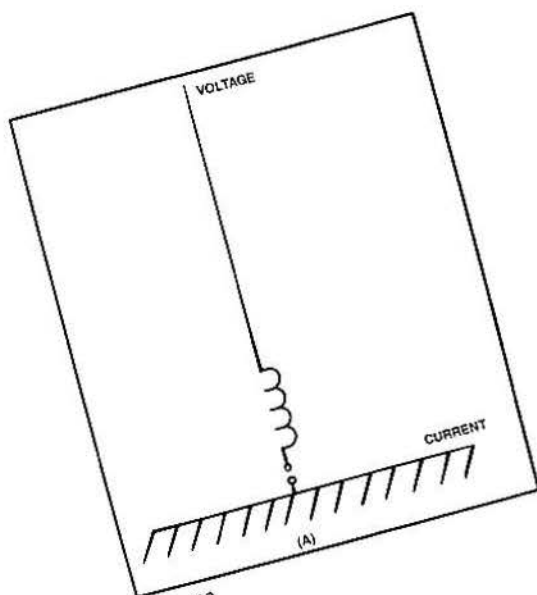
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**On the cover:** An experimental 440MHz vertical monopole antenna uses a printed circuit counterpoise for capacitive bottom-loading tests. See article on page 10.

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## The future is here, and its name is Fleet Call



With a sheet of paper—actually, a 49-page document and 75 more pages of exhibits, drawings and tables—Fleet Call has hit the radio communications industry in the face with its future.

Some two-way radio system operators have talked about implementing digital modulation and increasing frequency reuse to boost spectrum efficiency *sometime*...probably when cellular mobile telephone systems already have done it...certainly sometime this decade...probably around 1995...on *somebody's* frequencies. Fleet Call has stepped up and shouted *NOW!*

### Specialized mobile radio

Founded in 1987, Fleet Call made its first mark by purchasing \$250 million worth of major market specialized mobile radio (SMR) systems from existing licensees. SMR system licensees build and operate radio repeaters to relay signals from mobile and portable two-way radios they and others sell.

Repeaters are combination receivers-and-transmitters generally located at sites with commanding views. The repeaters pick up signals from mobiles and portables and rebroadcast them from the favorable sites so they are heard throughout the coverage area the customer wants. Customers who use the repeaters pay SMR system operators monthly fees for the relay service. Many customers buy their radios from the same SMR operators and obtain installation and repair service from them.

"Improving spectrum efficiency" usually means "putting more customers on the same frequencies." Trunking al-

lows more customers to use a given group of frequencies. "Trunking" means the customer's radio automatically selects a vacant channel from a group of frequencies served by an SMR licensee's repeaters. The customer does not have to wait for one particular channel to become vacant, thus speeding access to an available channel. With trunking, more customers can use a given number of channels, thus improving spectrum efficiency. Many SMR systems, including most of Fleet Call's, already use trunking.

### Boosting spectrum efficiency

Spectrum efficiency takes another step upward when several customers can use the same frequency at the same time. Fleet Call proposes to boost the spectrum efficiency of some of its SMR systems via two methods:

(1) *Time division multiple access (TDMA)*—Three or more customers can share the same frequency in the same location when their radios take turns transmitting several times per second. Digital modulation fills the gaps so the listener hears continuous sound. The technique *divides the time* and gives *multiple users access* to the same channel—time division multiple access.

(2) *Frequency reuse*—Repeaters at opposite ends of a metropolitan area can use the same frequency to serve different users without interfering with one another, provided repeater power and antenna height are limited.

### Outraged competitors

Present FCC rules do not allow SMR licensees to employ digital modulation, TDMA and frequency reuse. On April 5, Fleet Call asked the FCC to waive certain rules that stand in the way of implementing its proposed system. Portions of the waiver request have outraged some of Fleet Call's competitors.

Speaking at an open forum on May 10, Chuck Wells, an SMR operator in Los Angeles, said: "Let me tell you something. Maybe these people have read the public notice. But if they only have read the public notice they have no idea how ridiculous and monstrous this thing is and the effect it will have on everybody in the business. They better read the entire engineering report and

the waiver request. Otherwise they cannot judge."

Morgan O'Brien, Fleet Call's chairman, responded: "We encourage that, Chuck. We've been making the application—I think we made hundreds of copies at great expense, and we've been distributing them to anybody that's interested. There is nothing to hide."

### EGA rectangles

What disturbs many of Fleet Call's competitors is the company's request that the FCC establish *EGAs*. (EGA stands for "enhanced specialized mobile radio geographic area.") An EGA is a rectangular-shaped area surrounding a market. Within that area, no new SMR licensees would be permitted to establish transmitter sites on frequencies used by Fleet Call anywhere else within the EGA. No existing SMR licensees would be permitted to relocate any existing co-channel transmitter site to a new location within the EGA.

The EGA is intended to protect Fleet Call's systems from interference from high-powered SMR stations on the fringe of its service area. O'Brien said there are about a dozen people—"you know who they are"—who would place such transmitters near Fleet Call's service area to force the company to choose between intolerable interference or the purchase of the interfering systems at "greenmail" prices.

### Shaping the future

The FCC has at least several choices:

- Deny the waiver.
- Grant the waiver in the form requested by Fleet Call or in some modified form.
- Issue a Notice of Inquiry (NOI).
- Issue a Notice of Proposed Rulemaking (NPRM).

Traditional government procedure for handling a "hot potato" such as this matter is to delay making a decision as long as possible. That argues in favor of an NOI or an NPRM.

The FCC's mandate to foster new technologies and encourage spectrum efficiency argues in favor of granting Fleet Call's request speedily.

The commission will shape the future of the SMR service with its decision.

—Don Bishop



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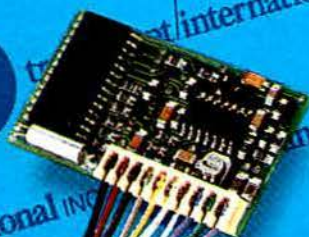
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## FCC enforcement:

In response to your story about unlicensed radio use ("FCC Study Indicates Extent of Unlicensed Radio Use," March issue, page 100), I have a few statements to make to FCC Field Operations Bureau chief Richard M. Smith and FCC Tampa field office engineer-in-charge Ralph M. Barlow.

First, the true culprit in the matter of unlicensed radio use is the FCC itself. After the deregulation of the two-way radio industry (dropping technician licensing requirements, for example) in the early 1980s came the advent of the mail-order radio supply house. Before this deregulation, the greatest percentage of radio shops handled their own licensing for their customers. They made sure that radios were not sold to customers who did not first have a license to operate them legally. For the most part, these shops were self-policing.

At present, mail-order companies sell radios at wholesale prices. Many of the

radios sold already contain frequencies usable by the purchaser upon receipt of the radio. In contrast to the radio shops of the past, mail-order companies do not care whether the user has a license. They do not care what frequency the user has selected and whether it was assigned by the FCC. In short, the mail-order companies are concerned with selling radios and making an easy profit—nothing else.

Because of the saturation of the market with wholesale-priced, user-programmed radios and the incredible ineptitude of the National Association of Business and Educational Radio (NABER) to provide usable frequencies in a reasonable amount of time, many shops have ceased to worry about licensing requirements. These shops are telling their customers (the few left that have not ordered radios by mail already) that it is their responsibility to obtain a license and operate legally.

The types of radios that may be or-

dered from the mail-order companies range from 1W portables on itinerant frequencies to 60W user-programmable mobiles, all the way up to low-power repeaters. All the customer is required to do is pick out a "dot" or any other frequency that pops into his head and then proceed to order his self-designed "system."

There is no need for Mr. Smith and Mr. Barlow to lay the blame for this mess on the remaining legitimate radio shops—shops now trying to stay in business in spite of FCC deregulation—when the real fault rests with the FCC.

If you have doubts about these statements, just remember that the 27MHz Citizens Band once was a useful communications band. Because of a lack of effective enforcement of its own regulations, the FCC quickly lost control of that band. The result of all this is the present useless, mindless RF sewer that is today's Citizens Band.

Tell me, can we expect the same to

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## Letters to the editor

happen to all of land mobile?

David H. McDonald  
Vice president  
Cybernetics  
Hickory, NC

er operation and licensing of stations and who are more interested in profit than proper use.

Michael F. Mozdierz Sr.  
S & M Communications  
Concord, VT

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- troubleshooting certain microprocessor units with scan information provided by the manufacturer, especially for software glitches.

R.M. Massenburg  
Massenburg Marine Service  
Ward Cove, AR

It would be difficult to research new products and service without your "Buyers' Guide" issue.

The most interesting article in the December 1989 issue is the "Direct Access" editorial comment.

Mine is a new business. The toughest problems I face are survival and expansion.

James W. Woodard  
Woodard LMR Engineering  
Alva, OK

February's entire magazine presents a well-balanced mix of technical information and new product availability.

The most interesting article was "How to Design and Use Radiating Cable Systems" by Udo Bode.

The two toughest problems faced on the job are:

- (1) troubleshooting half of a dual-frequency system that shares a common coaxial cable antenna.

- (2) getting cooperation from those responsible for maintaining the *second* half of the system!

Paul Rozinski  
NYC Transit Police Department  
Communications Division  
Brooklyn, NY

I enjoy all of your publications.

The most interesting article in the January issue is "Structure Your Site For 'Technical' Success" by Alex Dolgosh and Ron Jakubowski.

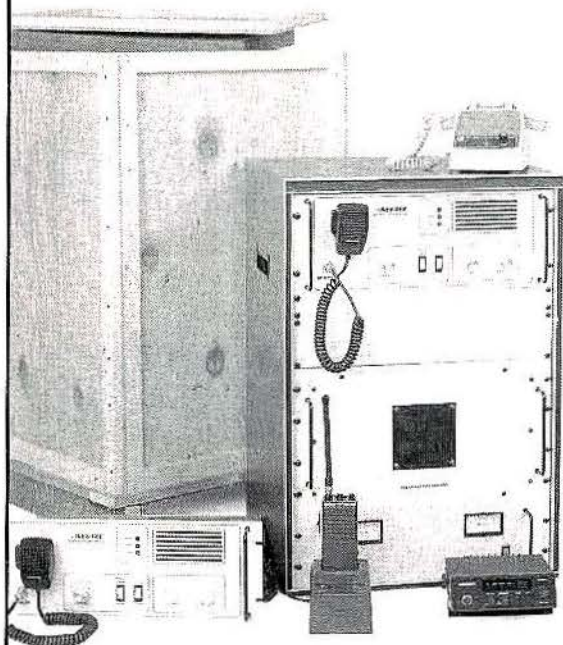
The toughest problems facing me on the job are intermod problems and:

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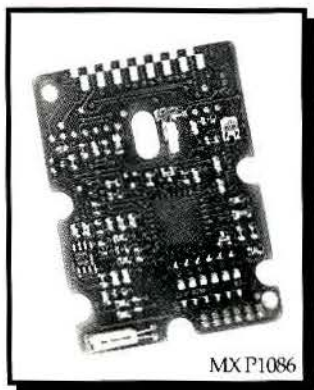
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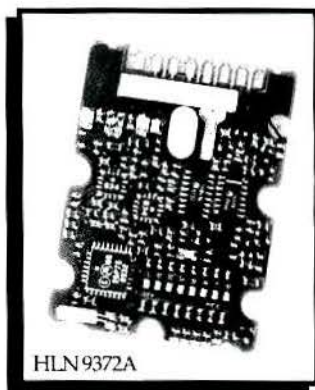
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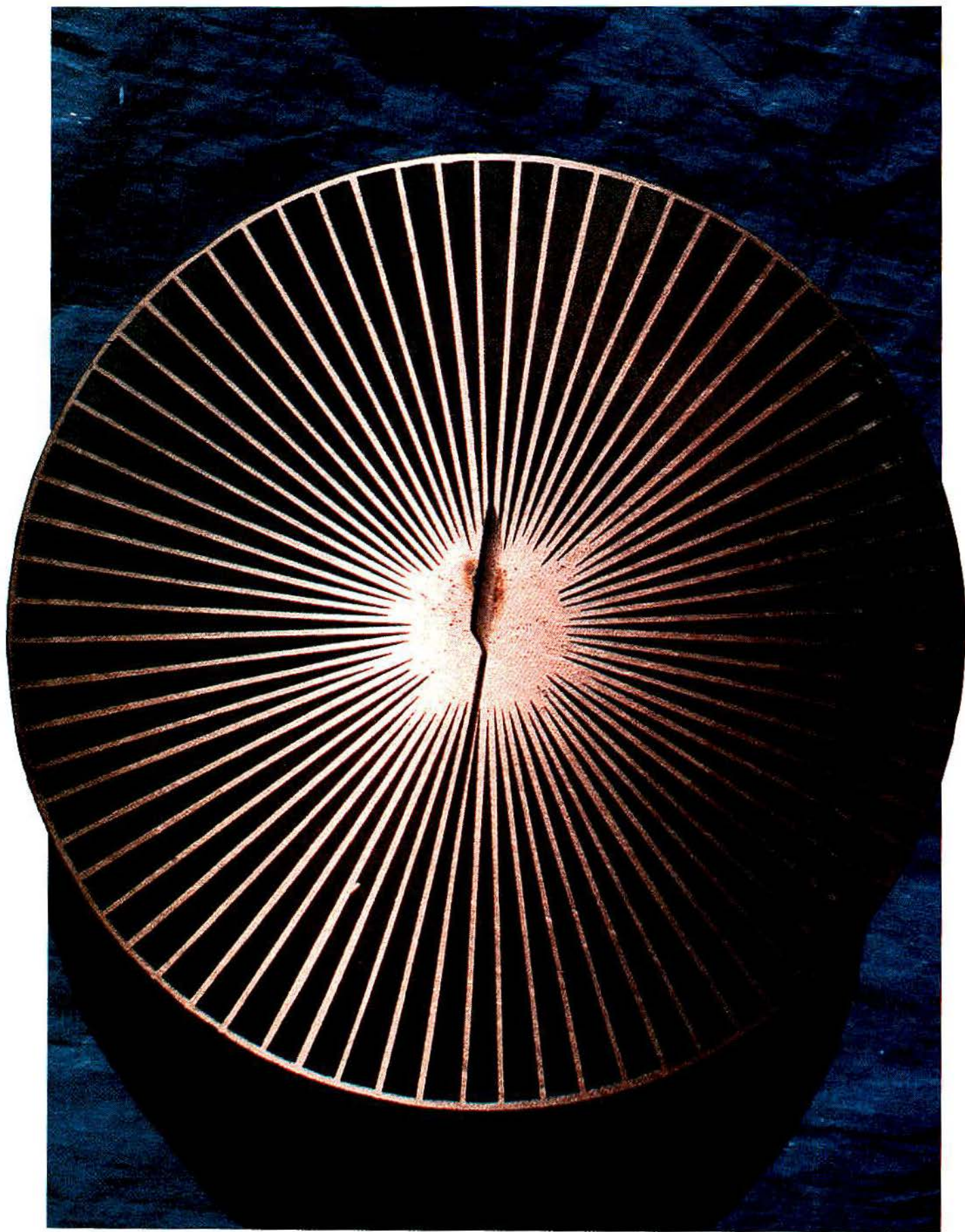
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# Capacitive bottom-loading tunes mobile antennas

*Capacitively bottom-loaded antenna experiments develop several practical mobile antennas. The vertical element length does not need to be changed to compensate for different frequencies or vehicles.*

By A.C. Doty Jr.,  
John A. Frey and  
Harry J. Mills

Loading vertical antennas to reduce their physical height is not a new idea. Verticals often are loaded inductively, as with "top-loading coils" and "base-loading coils," and capacitively with "top hats."

The idea of capacitive bottom-loading, although mentioned in the literature as early as 1938<sup>1</sup>, apparently has not been tested or applied extensively.

The authors conducted a series of tests to better define and quantify the capacitive bottom-loading effect. The emphasis in these tests was to determine what range of frequencies could be attained with a fixed height of vertical element by varying the value of the capacitive bottom-loading.

In deriving the test program, it was considered that the capacitive bottom-loading effect may be described as follows:

As the frequency of operation is raised, an antenna of fixed length looks at its base feedpoint as an increasing resistance in series with a decreasing capacitance. The resulting inductive reactance at the feedpoint must be tuned out, which necessitates the use of capacitive reactance, which is provided by a capacitor.

**To the left: A top view of a 450MHz test antenna built with printed circuit board material.**

Photo 1 below shows a side view of the antenna displayed on the cover and at the left. Photo 2 on page 12 shows a sample of a number of 440MHz folded monopole antennas over counterpoises that were built for test purposes. Test data in Table 1 on page 20 show the resonant frequency and VSWR of a folded monopole element and counterpoise antenna system over different ground configurations.

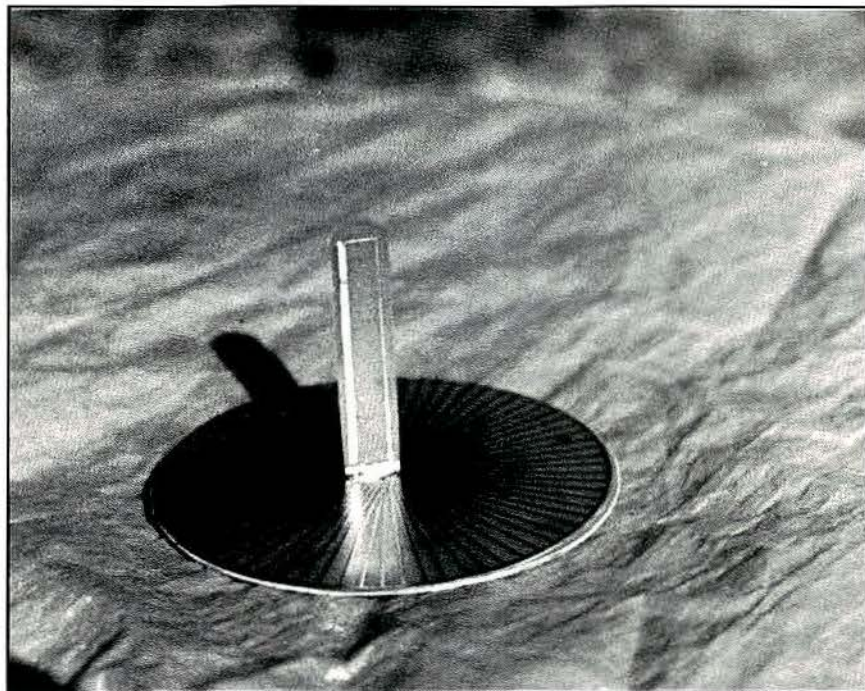
In the tests, a sufficiently accurate impedance bridge was not available, so VSWR data were taken instead. The data and subsequent tests show:

(1) The resonant frequency of a

quarter-wavelength vertical antenna used with a counterpoise varies as the size of the ground system (or plate, in the design tested) under the counterpoise. The larger the ground system, the lower the resonant frequency.

(2) The resonant frequency of a vertical antenna used with a counterpoise varies with the distance between the counterpoise and the ground. The greater the distance, the higher the resonant frequency.

In other words, the capacity between the counterpoise and ground acts to capacitively bottom-load the vertical element.



**Photo 1.** This side view shows an experimental antenna similar to the one shown on the cover and at the left. The vertical element is a folded monopole etched from printed circuit board.

Material in this article, part of a more extensive paper, was presented on Nov. 27, 1987, at the Radio Club of America Technical Symposium.





Photo 2. These experimental antennas were used to test various methods of capacitively bottom-loading vertical antennas for VHF and UHF.

In the antennas tested, capacity was added between the feedpoint of the antenna and the ground system to supply the required capacitive reactance. By varying the value of this capacitive reactance, the frequency at which the base impedance of the antenna is purely

*So far as is known, no one has undertaken commercial manufacture of capacitively bottom-loaded antennas.*

resistive, i.e., its resonant frequency, was varied.

Tests described on pages 14 and 16

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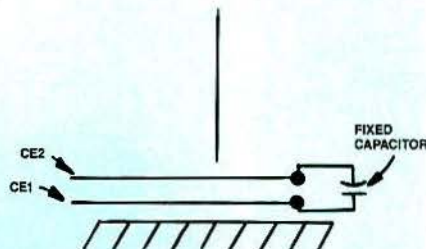
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## Antenna tests

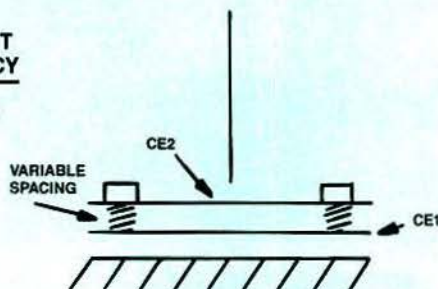
**Test No. 1**—The capacitance between capacitive element No. 1 (CE1) and capacitive element No. 2 (CE2) was varied by inserting fixed capacitors. The resonant frequency of the antenna system was found to vary as shown below.

CAPACITANCE ADDED BETWEEN CE1, CE2	RESONANT FREQUENCY
NONE	30.70MHz
28 Pfd.	30.05
52	29.95
75	29.90
100	29.70
150	29.30
200	28.90
250	28.80
400	28.10
500	28.00
1,000	27.80



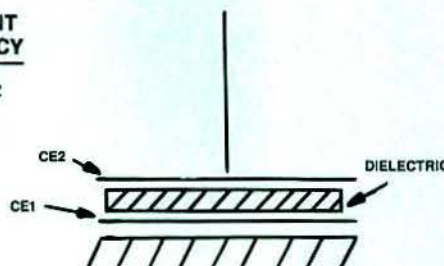
**Test No. 2**—Spacing between capacitive element No. 1 (CE1) and capacitive element No. 2 (CE2) was varied. The resonant frequency of the antenna system was found to vary as shown below.

SPACING CE1 TO CE2	RESONANT FREQUENCY
1/8"	28.7MHz
3/8"	28.7
1/2"	30.1
7/8"	30.9
1 3/8"	32.1



**Test No. 3**—Three different materials were inserted between capacitive element No. 1 (CE1) and capacitive element No. 2 (CE2). Each material had a different dielectric constant. Resonant frequency of the antenna system was found to vary as shown below.

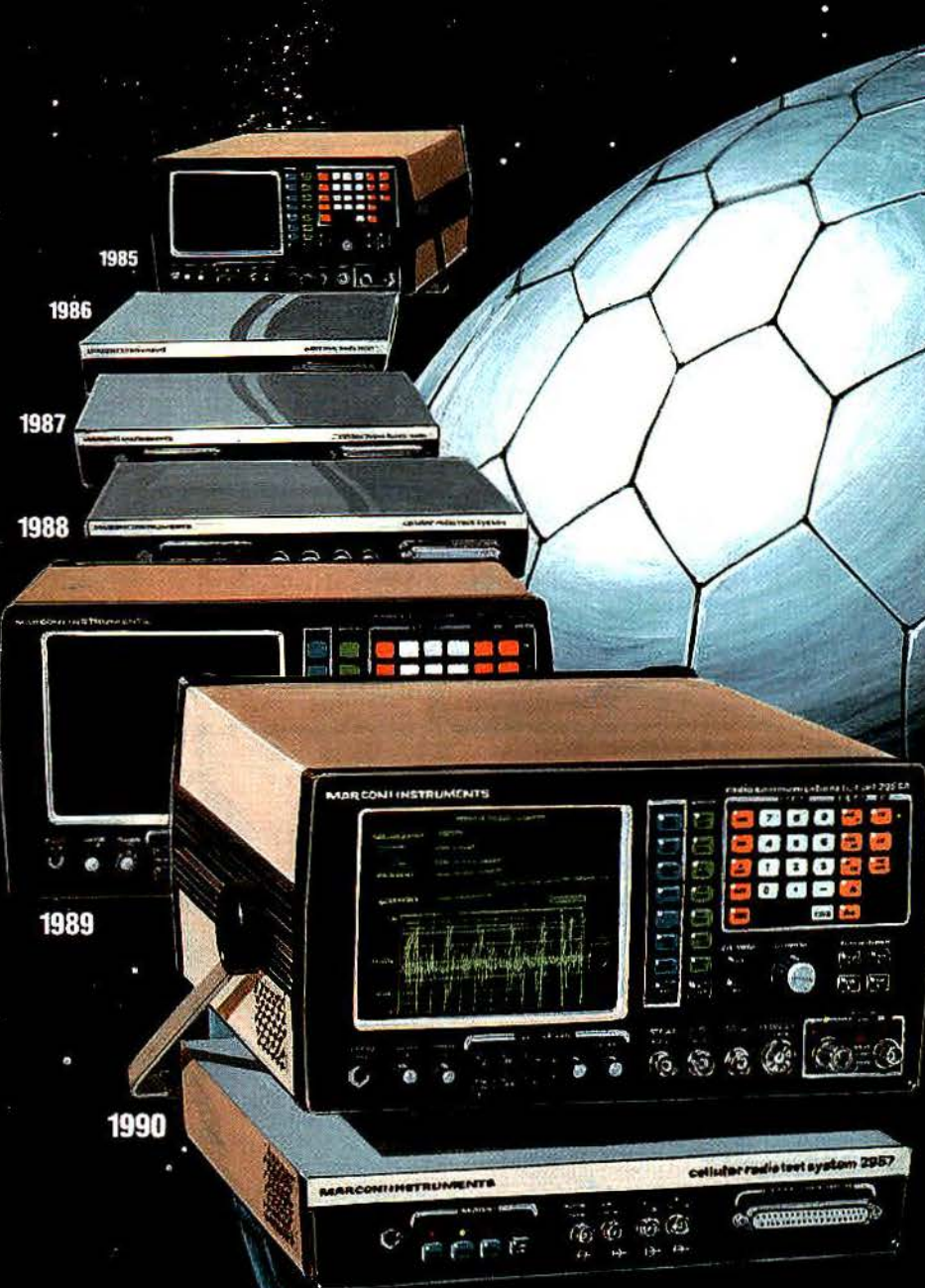
MATERIAL	RESONANT FREQUENCY
1/4" PERFBORAD	28.7MHz
1/4" PLASTIC	28.9
1/4" PLYWOOD	29.2



continued on page 16



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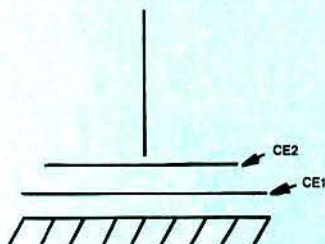




continued from page 14

**Test No. 4**—The diameters of capacitive element No. 1 (CE1) and capacitive element No. 2 (CE2) were varied. Resonant frequency of the antenna system was found to vary as shown below.

DIAMETER CE1	DIAMETER CE2	RESONANT FREQUENCY
24"	24"	25.2MHz
24"	11"	29.4
24"	5 5/8"	35.0
24"	5 1/8"	36.4



were conducted with two 11-inch diameter copper-clad printed circuit board plates adjacent to the base of the vertical element.

A number of antennas for use on

440MHz, 145MHz and 29MHz have been built to evaluate the practical aspects of capacitive bottom-loading.

The 29MHz model was tested extensively and found to be tunable from

25.9MHz to 31.5MHz without changing the height of the vertical element. On-the-air performance on the amateur 10-meter band was excellent.

Photo 3 on page 18 shows a 145MHz mobile antenna constructed with the capacitive bottom-loading feature. In months of on-the-air use, this feature has allowed tuning the antenna over a considerable frequency range as it was relocated to different positions on several vehicles. Performance has been consistently excellent.

So far as is known, no one has undertaken commercial manufacture of capacitively bottom-loaded antennas. Construction of practical models has continued. Because the authors are licensed radio amateurs, frequencies are available to them for experimentation without additional licensing. Models have been built for use from 3.5MHz to 450MHz. Doty has made a few 800MHz versions for use with his cellular telephone. Each of the antennas boast simple construction because they

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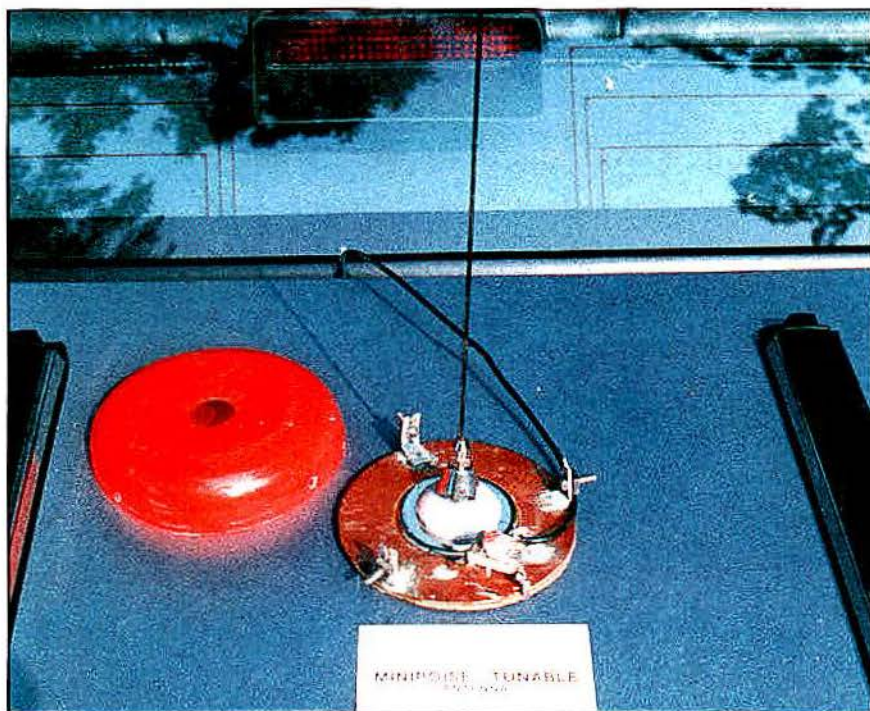


Photo 3. This 145MHz antenna features adjustable capacitive bottom-loading for tuning the antenna across a range of frequencies without adjusting the length of the whip.

have fixed, rather than adjustable, whips.

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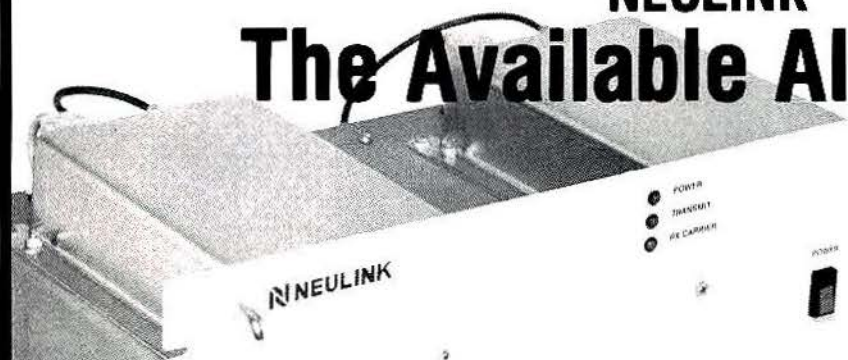
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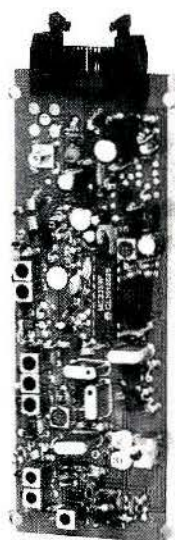


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**TABLE 1—Resonant frequency of a folded monopole radiator and counterpoise antenna system over different ground configurations.**

**TEST FREQUENCY:** 440MHz to 450MHz  
**ANTENNA:** Folded monopole "4A"  
**COUNTERPOISE:** 11" diameter, 72-radial, printed circuit "C"  
**RF POWER INPUT:** 1.2W from Kenwood 4AT transmitter  
**RF REFLECTED POWER:** Measured with Bird Model 43 with 1W element

**RESONANT FREQUENCY AND (V.S.W.R.)**

GROUND*	Spacing—Counterpoise to Ground Plate			
	NONE	1/8"	1/4"	1/2"
None	>450 (1.138)	—	—	—
11" diameter (CP "C")	>450 (1.138)	>450 (1.150)	>450 (1.165)	>450 (1.178)
16" x 18" Rect.	442 (1.060)	442 (1.060)	442 (1.085)	442 (1.138)
23" Round	440 (1.060)	440 (1.060)	440 (1.138)	440 (1.201)
32" Round	<440 (1.190)	<440 (1.190)	<440 (1.222)	<440 (1.242)

**NOTES:** For these tests an antenna having a resonant frequency above 450MHz (with no ground) was deliberately selected to show the effect of the various ground plates.

\* "Grounds" were copper-plated printed circuit boards.

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15. Doty, Frey and Mills, "Efficient Ground Systems for Vertical Antennas," *QST*, February 1983.



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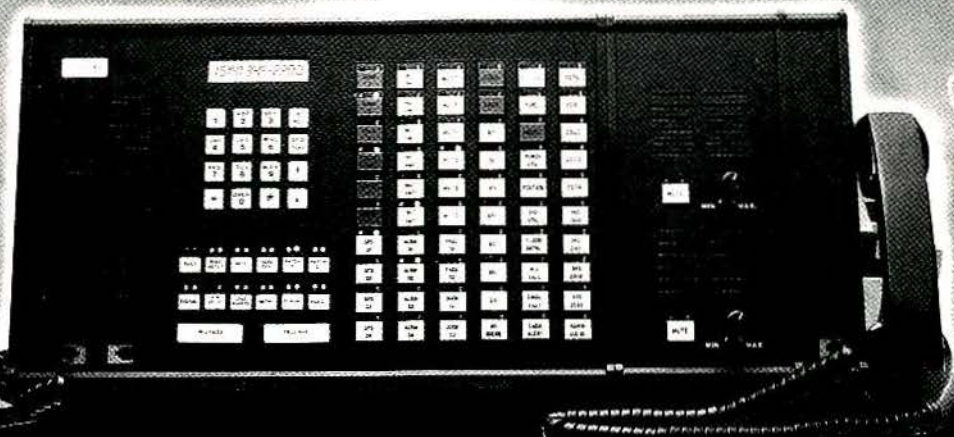


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# 'If it's not a whip, it won't work'

*That's the reaction of many radio technicians, installers and users to mobile antennas that do not look like vertical whips. Here's how short antennas work, and how height reduction affects antenna efficiency.*

By Jim Waldron

Short mobile antennas offer advantages for mounting, concealment and less exposure to damage. Classic mobile antennas are formed from stainless-steel whips. The less a mobile antenna looks like the classic whip, the more skepticism it seems to generate.

An explanation of some of the most widely used methods of reducing mobile antenna height might help to build confidence in shortened antennas.

## Base loading

Figure 1 on page 24 shows one method of shortening a quarterwave mobile

Waldron owns Com-Rad Industries, Grand Island, NY.

whip antenna. With the whip section shortened *physically* to less than a quarter-wavelength, a lumped inductance (loading coil) replaces the "missing" length of whip to restore the *electrical* length to a quarter-wavelength.

When RF energy is applied to a quarterwave ground plane antenna, the highest current flows at its base. A loading coil placed at the base causes rather high power loss, as defined by the equation  $I^2R = P$ , where  $I$  = current;  $R$  = resistance; and  $P$  = power.

Virtually all mobile antennas are designed with 50Ω feedpoint impedance to match commonly used 50Ω coaxial cable. The 50Ω impedance has two components, radiation resistance and conductor resistance. For a given antenna, the lower the radiation resistance, the higher the conductor resistance, assum-

ing the total impedance is 50Ω.

Figures 2 and 3 on pages 26 and 28 show radiation resistances for various antenna wavelengths. These figures express wavelengths as degrees. One wavelength is 360°; a half-wavelength is 180°; and a quarter-wavelength is 90°.

The radiation resistance of a quarter-wave (90°) whip is about 35Ω. Shortening the whip to one-half the length, 45°, reduces its radiation resistance to 7Ω. If a 45° base-loaded whip provides a good match to 50Ω coaxial cable, it means 43Ω of the total impedance is conductor resistance. Thus, 14% of the power fed to the antenna is emitted as radio energy and 86% of the power is dissipated as heat, mostly in the coil and a little in the whip. The equation for calculating antenna efficiency is:

$$\text{Efficiency} = \frac{\text{Radiation resistance}}{\text{Total impedance}}$$

Try an experiment. Key a 100W transmitter for a few minutes into a base-loaded antenna mounted on a vehicle. Then feel the loading coil. Warm, is it not?

Some designers place the coil near the center of the whip instead of at the base. The center placement raises the radiation resistance and therefore the antenna's efficiency.

## Continuous loading

Another way to shorten a whip antenna is to continuously load it, as with a helical winding. (See Figure 4 on page 30.) A helical winding reduces the  $I^2R$  loss by spreading the coil into the shape of a helix along the entire length of the antenna element. Because the coil, or helix, becomes the radiating element,

## Why some people reject non-whip antennas:

- ☐ Resistance to change.
- ☐ Many of the low-profile antennas, including the directional discontinuity ring radiator (DDRR) antenna, are considered ugly or silly looking, so they conclude the antennas cannot possibly work.
- ☐ Technicians do not want to be bothered with some of the peculiarities of installation and tuning.
- ☐ Non-whip antenna performance, in some cases, has not lived up to the manufacturers' claims because sound design principles were not followed.



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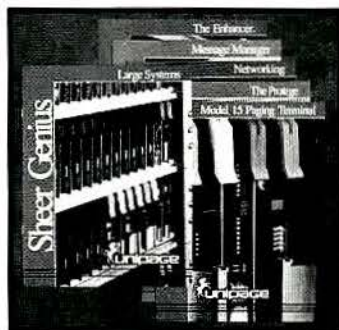
But you should stop and consider the company

that would treat a customer this way. This is not the company that made your original system. This is not the company that supported you for all these years. The old company is gone. Many of the familiar people are gone.

Consider the alternative. There is another system manufacturer that can provide the enhanced services that you need to compete in today's paging market. There is a company that can provide a system to meet your needs today without restricting your growth tomorrow. There is a company that considers you as a partner, and that will support your business through its inevitable growth. There is a group that understands paging from your point of view.

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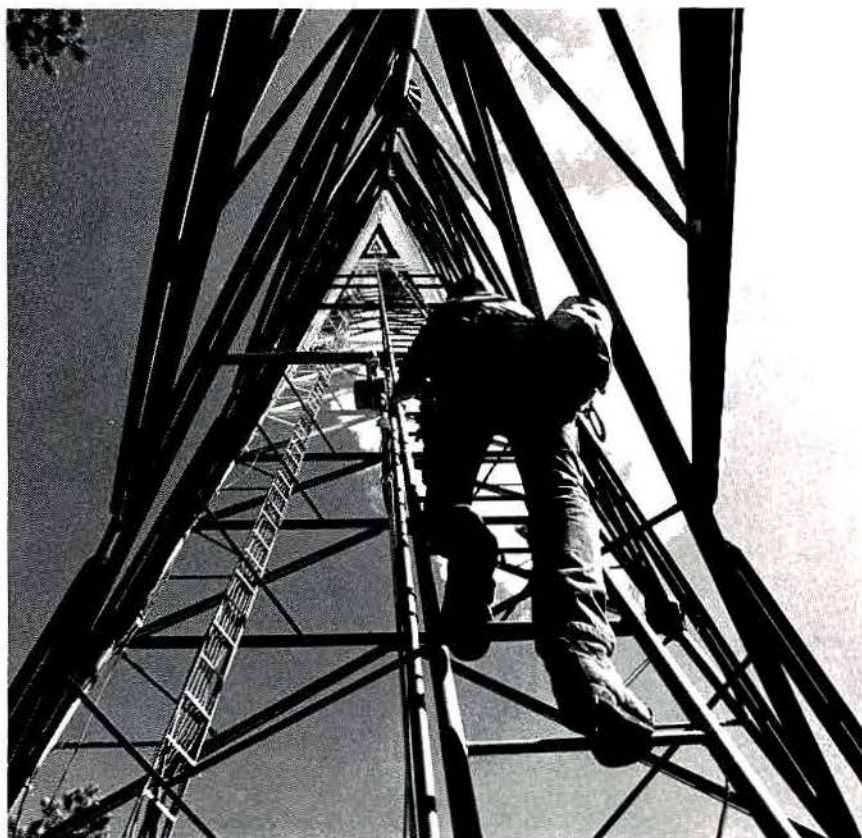
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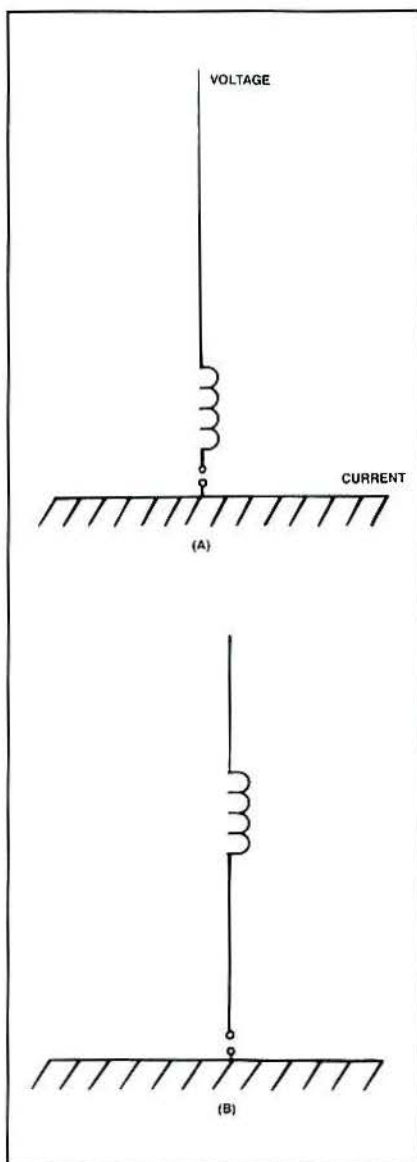


Figure 1. One method of reducing the height of a quarterwave mobile whip antenna uses a lumped inductance at the base (A). The resulting low radiation resistance boosts  $I^2R$  losses as conductor loss becomes a proportionally larger component of the antenna impedance. At (B), the lumped inductance is placed near the center of the antenna, raising its radiation resistance and reducing  $I^2R$  losses.

its radiation resistance increases and so, therefore, *should* the antenna efficiency.

Offsetting the expected increase in efficiency is the common use of fine wire for the helix. Fine wire has more resistance than the heavier stock used to make metal whips and many loading coils. Furthermore, the wire normally is supported by a fiberglass and plastic form shaped like—a whip. The combi-



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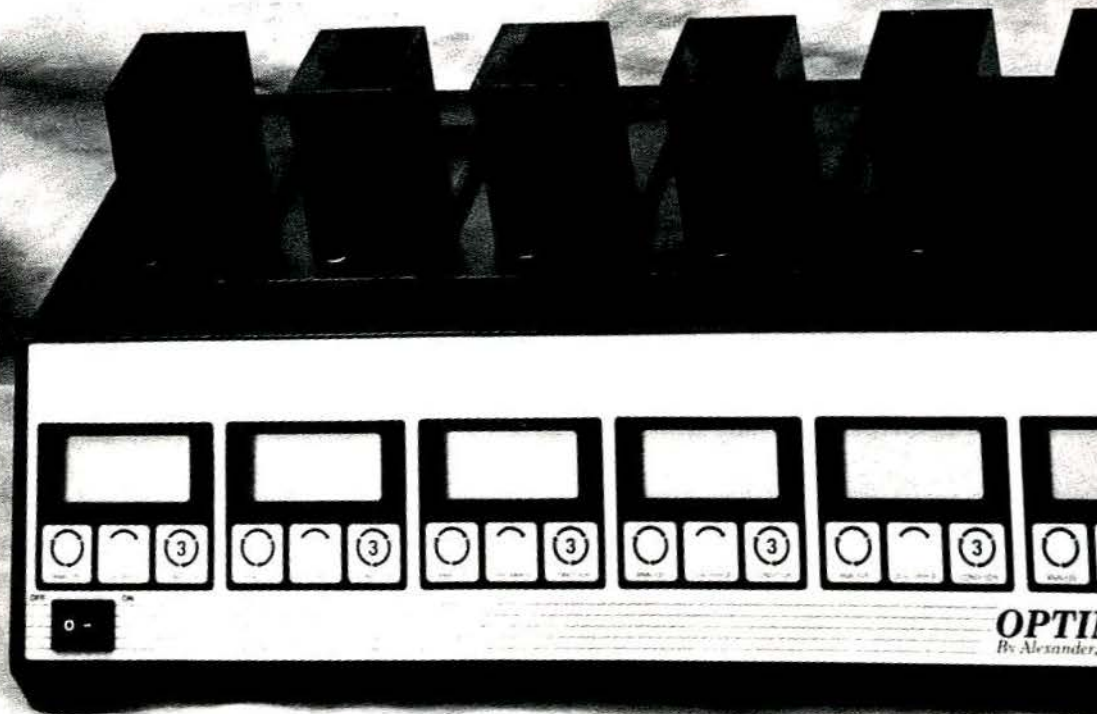
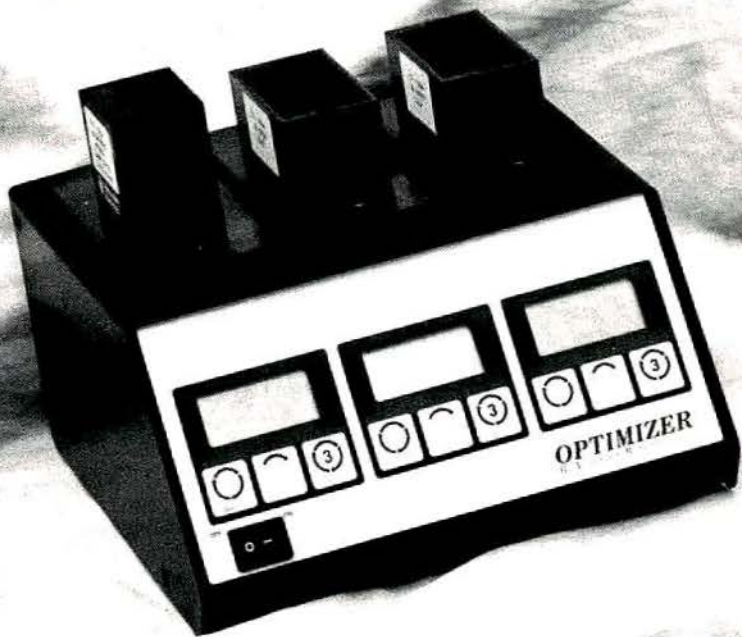


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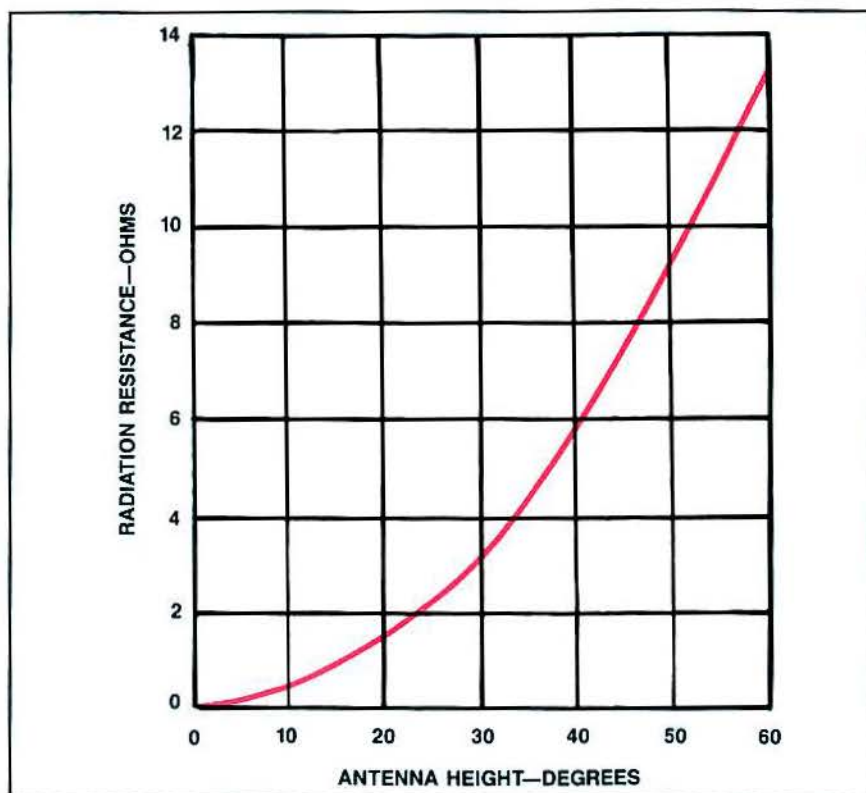
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By Alexander





nation of fine wire and fiberglass-plastic form that supports it is lossy at radio communications frequencies.

Although both methods (lumped in-

*Although both methods (lumped inductance and the continuous loading) of shortened mobile whips perform acceptably...*

ductance and the continuous loading) of shortening mobile whips perform acceptably, the resulting antennas still are

Figure 2. Radiation resistance for antennas from 0° to 60° in height.

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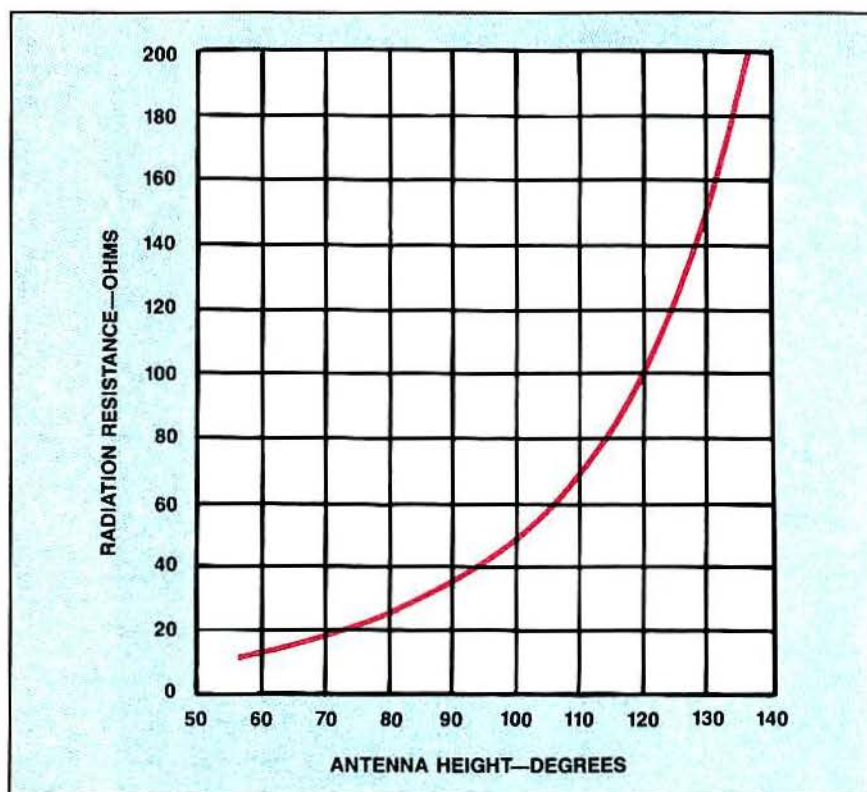
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whip-shaped and are not short enough to eliminate all of the problems associated with whips.

*...the resulting antennas still are whip-shaped and are not short enough to eliminate all of the problems associated with whips.*

Making a short helix antenna offers one solution. To make the helix extremely short requires increasing its di-

Figure 3. Radiation resistance for antennas from 50° to 140° in height.

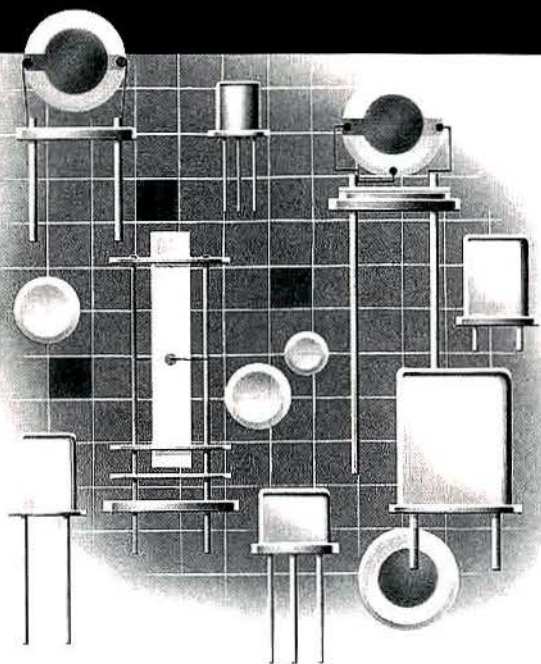
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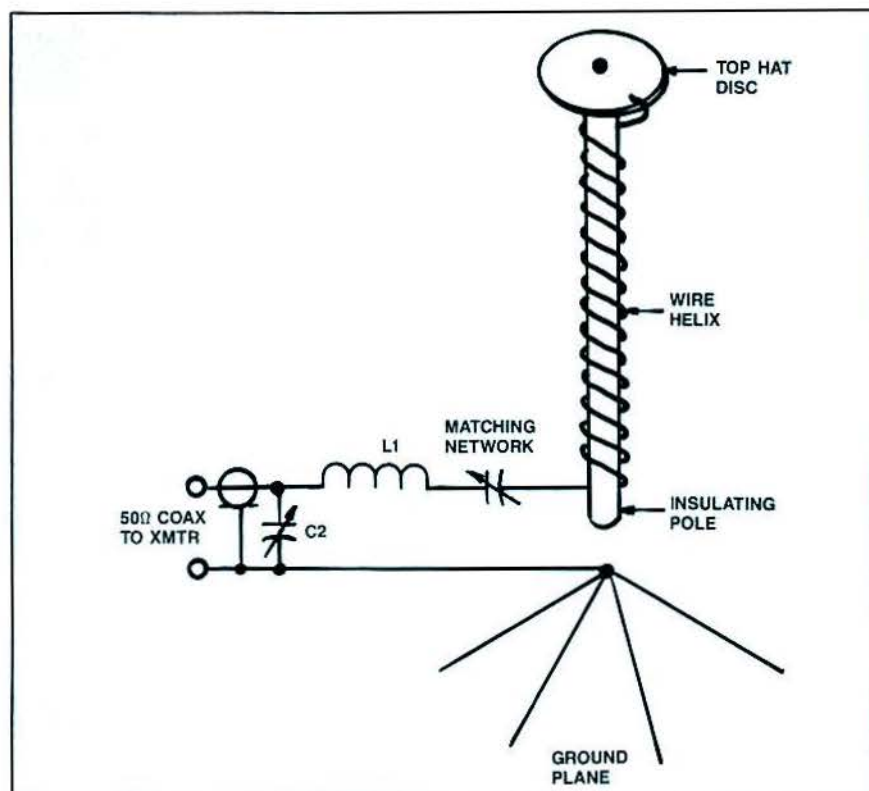
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ameter. A large-diameter, short helix looks more like a spring than a whip.

Building the helix from tubing instead of fine wire reduces conductor resistance, increases its bandwidth and gives it a rigidity that makes a plastic support unnecessary. Figure 4 shows a helix design. With the use of a big diameter winding and a shunt feed, the top hat and matching networks are not needed.

The use of tubing, a large diameter and a shunt feed reduces conductor losses to a point where the short helix's efficiency exceeds that of loaded whips. The helix's rigidity eliminates signal strength variations that may be caused when whips flex.

#### Extremely short vertical

A lumped inductance at the base or center of a quarterwave whip may be used to shorten the antenna. So can

Figure 4. Continuously loaded 'helical' antennas may be matched to 50Ω with a network or a shunt feed. Some helical antennas match 50Ω because their conductor resistance is so high.



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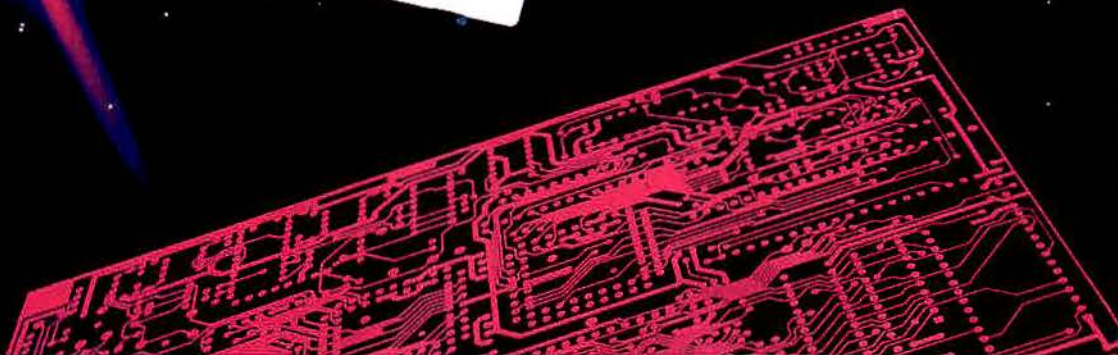
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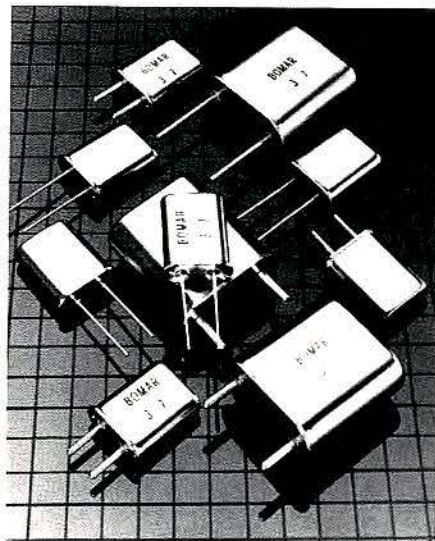
lumped capacitance placed at the top of the whip. The lumped capacitance can be formed by a top hat made of a metal disk or a wire frame shaped like a wheel with spokes. It can be made into a sphere or it can consist of a continuation of the main element bent into a horizontal plane. Figure 5 (on the right) shows some of the configurations.

Voltage and current that flow in the

top hat are canceled by their voltage and current images that flow in the ground plane. The cancellation leaves the extremely short vertical section as the antenna's principle radiating element.

Extremely short, capacitively top-loaded antennas with an extended horizontal section have been given various names, including directional discontinuity ring radiator. But they can be

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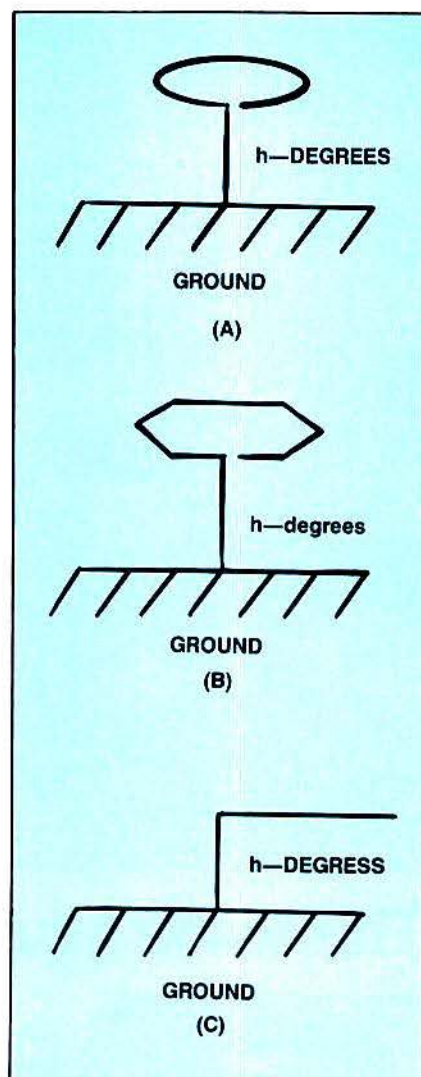


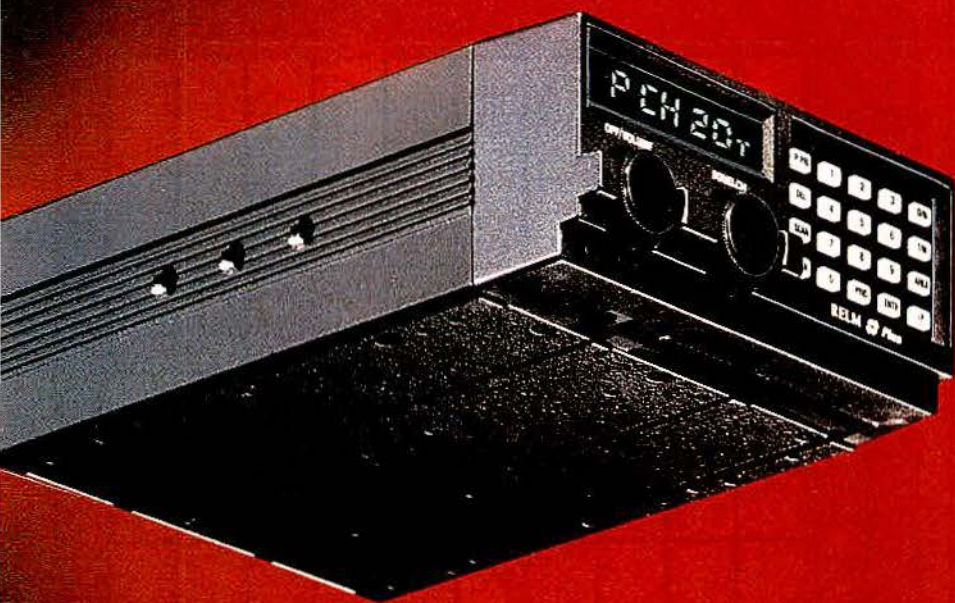
Figure 5. Extremely short, top-loaded antennas also are known as transmission line antennas. The top loading may be accomplished with a disc or a wire grid. Alternatively, the antenna element may be extended horizontally.

thought of as *transmission line systems*, meaning that the spacing between the top hat and ground is extremely small and that voltages and currents flowing in parallel along the top hat and ground plane cancel one another.

Successful transmission line antenna design depends on two factors: vertical element height and conductor loss.

Figure 6 on page 32 shows the relationship between vertical element height (expressed in degrees) and conductor loss with respect to antenna efficiency. The height of the vertical stub should be as great as possible, in keeping with the objective of the antenna's low pro-





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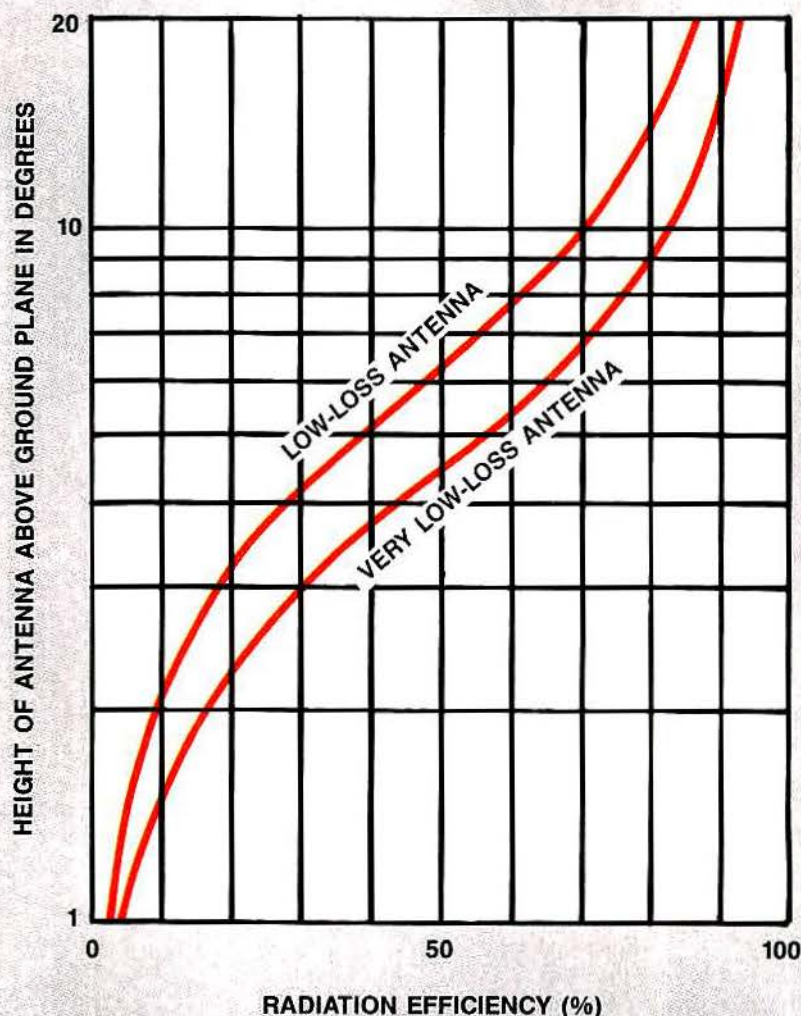


Figure 6. With low conductance loss, a transmission line antenna with a 90° horizontal element fed by a section only 20° high can achieve efficiencies approaching 90% or more.

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file. The antenna element should have a large conductive surface to reduce conductor loss. The graph in Figure 6 shows that with element height of 20° and the use of a low-loss conductor, antenna efficiency can approach 90% or more.

Mobile antennas of the transmission line type can be covered with protective radomes for use where whips are impractical. They can be mounted inside and underneath vehicles. They are less obvious than whips, making them less susceptible to theft, making it less obvious that radio or telephone equipment is inside the car and making them attractive for use in surveillance.

Extremely short antennas seem to couple into the environment more readily than whips. Whips project above light bars, tool boxes and other vehicular accessories. When a short antenna couples into a nearby object, the antenna becomes detuned with respect to frequency and input impedance. The detuning can be remedied if the antenna is designed for field adjustment,

which is a must for successful antenna performance.

Several manufacturers make antennas that use lumped inductance whips, helically wound whips, short helices and transmission line configurations.

Solving your problems with an alternative antenna design could be worth the razzing and flak you may hear from those who tell you, "If it's not a whip, it won't work."

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2. Belrose, John S., "Transmission-Line Low-Profile Antennas," *QST*, December 1975.
3. Bishop, Don, "Helical Antennas Replace Low-band Quarterwave Whips," *Mobile Radio Technology*, pp. 38-44, September 1989.
4. Bishop, Don, "Undercover 'Antenna' Goes Underneath Unmarked Cars," *Mobile Radio Technology*, pp. 20-21, September 1986.



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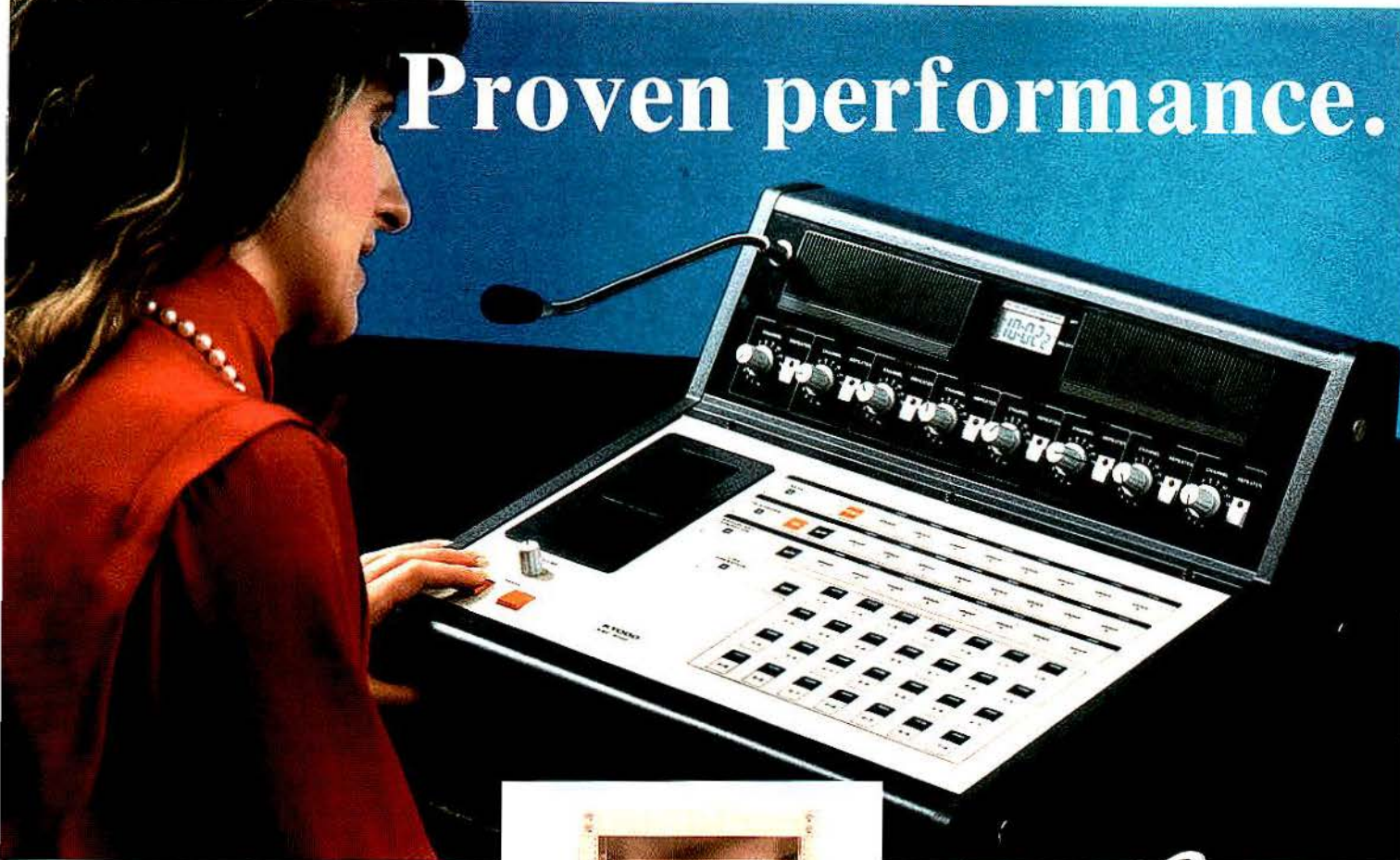
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# What it will take to cure mobile RF interception

*Electronic devices in vehicles that emit and intercept unwanted RF energy cause problems ranging from communications difficulties to safety risks. Technology and regulation offer solutions.*

By Robert H. Schwaninger Jr.  
and Alvin Markwardt

Vehicles driven by two-way radio and mobile telephone users are battlegrounds for *spectrum supremacy*. Autos and trucks carry multiple RF energy sources, some of which may disrupt the operation of receivers, engines, brakes and accessory equipment.

Silently and invisibly, receivers strain to isolate radio signals. Microprocessors bang out clock rhythms to push data through gates. Ignitions flash RF lightning. Transmitters scream to be heard above the din.

Incidents of unwanted interception by one device of RF energy generated by another are increasing:

Antilock brake devices intermittently lock up as an on-board UHF, VHF or HF transmitter activates or passes by while broadcasting.

Microprocessor-controlled fuel injection devices malfunction as a 15W VHF or UHF transmitter broadcasting from another vehicle passes by.

Car air conditioning units turn to full heat when a transmitter activates in the vicinity.

## Who's responsible?

• **Radio dealers**—RF interception problems confront two-way radio and mobile telephone dealers when a customer asks why his radio and vehicle are

not compatible. A better informed dealer can answer the question and resolve the problem. Because two-way radios and mobile telephones usually are the *last* items to be installed after the vehicle is assembled and the accessories are in place, customers assume the radios and telephones are at fault and that the radio dealer must be responsible.

• **FCC**—The FCC regulates devices that emit RF energy. But the agency does too little in making sure various RF devices are compatible with one another in the "RF environment." Industry, perhaps through necessity, does far

more to design devices to fit the "vehicular environment" than the FCC does in creating reasonable regulations to protect the RF environment. Of the many RF devices often found in a vehicle, few are subject to effective FCC regulation. (See box below.) The remainder must be designed by engineers who appreciate the regulatory backdrop.

• **Auto dealers**—RF interception is not a subject most auto dealers understand. An informal survey of dealers indicates the subject is not covered in training classes.

Out of 1,000 vehicles in use, perhaps

## RF energy sources in vehicles

- ☐ on-board computer system.
- ☐ spark plug ignition.
- ☐ RF car alarm system.
- ☐ garage door opener transmitter.
- ☐ electric motors for windows, windshield wipers and fans.
- ☐ digital watch on the driver's wrist.
- ☐ two-way radio.
- ☐ mobile telephone.
- ☐ pager.
- ☐ laptop computer.
- ☐ radar detector.
- ☐ broadcast radio receiver.
- ☐ brush motor devices that may be plugged into the cigarette lighter socket.

Schwaninger is a partner in the Washington, DC, law firm of Brown and Schwaninger. Markwardt is a communication engineer, electromagnetic engineer-technician, IEEE life senior and Radio Club of America member.





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as few as 25 to 35 may be involved in RF interception problems. Examples include cars or trucks that fail to start when near active transmitters and collisions caused by braking system failures.

• *Auto manufacturers*—Many auto warranties define non-factory-installed equipment as vehicle modifications. They go on to say that a modification that damages a factory part may void the warranty. In practice, a two-way radio transmitter or mobile telephone that affects a vehicle's operation or damages a vehicle computer or control system may void the warranty.

#### The regulatory fix

RF sources may be divided into two categories, regulated and non-regulated. Non-regulated devices include spark plugs, power lines, wiper motors, heater motors, power window motors, alternators and most of the brush motor devices that plug into cigarette lighter sockets. These devices cannot be affected by RF they intercept. RF they create is unregu-

#### RF energy sources outside the vehicle

- ☐ power lines.
- ☐ cable TV lines.
- ☐ industrial RF lighting devices.
- ☐ radar guns.
- ☐ transmitters of all kinds.

lated by the FCC. Radio spectrum users simply must live with the RF pollution

created by these unregulated devices. Nevertheless, manufacturers have done a reasonable job of desensitizing other devices to RF generated by these unregulated devices.

The remainder of the devices are regulated, in some manner, by the FCC. If it did in fact regulate all the other devices, the FCC would be doing a comprehensive job. But the manner of regulation is quite telling.

Regulated devices can be divided into two subcategories, operator regulation and production regulation.

• *Operator regulation*—In many cases, the FCC regulates an RF device's operation, not the device's manufacturer. The vehicle's driver thus has all the responsibility for his use of the radio spectrum. Considering the average consumer's level of sophistication about electronics, this form of regulation is mostly ineffective.

For example, the use of a car's on-board computer system is subject to FCC regulation, but its manufacturer is not. If the on-board computer emits RF

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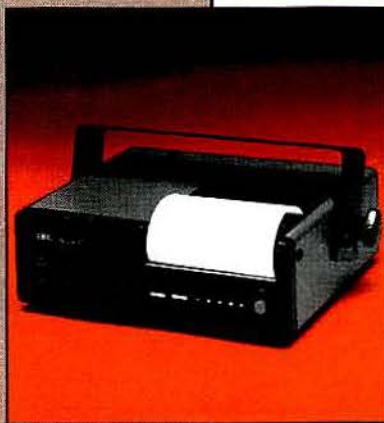
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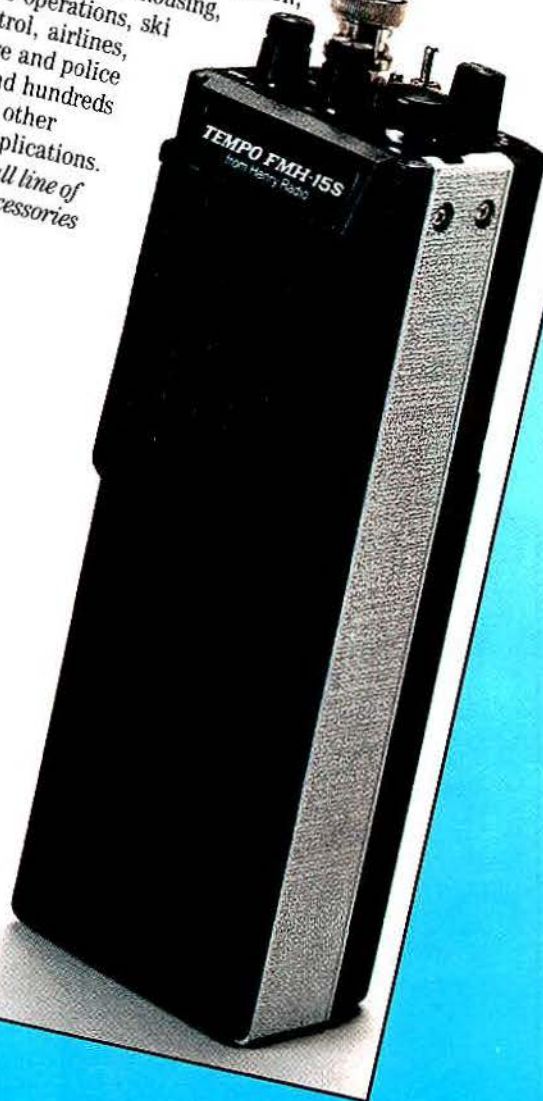
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energy that is intercepted by other electronic devices, the car manufacturer is not responsible to the FCC. Instead, FCC rules make the driver of the car responsible for protecting the RF environment—protection made necessary by the inadequate design of the on-board computer. Although this explanation is legally correct, try to tell it to the person who spent a few thousand dollars on a cellular telephone only to discover it does not work in his \$40,000 car because the on-board computer emanates spurious emissions.

• *Production regulation*—Although the FCC regulates many devices used in vehicles and used where vehicles travel, the agency does not test most new devices to see whether they emit excessive RF and tests no devices to see whether they intercept RF from other devices too easily. Instead, the FCC creates production rules and accepts applications for authority to market RF devices. These applications include test reports that show compliance with FCC emission standards. Based on the appli-

cant's assertions, the FCC grants authority to market and sell the devices in the United States.

---

*The FCC grants  
authority to sell a  
device, not to make a  
device. This means  
manufacturers are not  
automatically  
responsible for devices  
they produce.*

---

This method regulates laptop computers, two-way radios, mobile telephones, garage door openers, radar detectors, pagers and other devices. The

FCC grants authority to *sell* a device, not to *make* a device. This means manufacturers are not automatically responsible for devices they produce. If the manufacturer is an offshore producer, for example, it is the importer who is responsible to the commission, not the manufacturer.

A manufacturer who wants to sell devices under its own name must obtain authority from the FCC. The manufacturer becomes responsible for meeting RF emission regulations for its equipment. Many of the largest names in two-way radio, mobile telephone and paging equipment are directly responsible to the FCC for their equipment.

But many manufacturers do not market their own equipment. Instead, a distribution or retail entity acquires FCC authority by filing its own application. FCC rule enforcement, therefore, may become focused on the integrity and knowledge of "XYZ Importers and Distributors," whose address and existence rarely are verified by FCC staff.

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formation collection, FCC regulation might work better. In particular, a greater effort to verify the contents of applications would go a long way toward protecting the radio environment.

Unfortunately, FCC records are filled with examples of grantees of FCC authority who have cut corners and who have marketed devices that either do not function well in an RF environment or that prevent other devices from functioning properly. As the FCC enforcement dollar continues to shrink, incidents of improperly manufactured and marketed RF devices will increase and the threat to the consumers' RF environment will become greater.

#### No application needed

There is a class of devices for which no application is submitted to the FCC. Instead, the manufacturer simply states it has produced a device that complies with the FCC rules. The grant of FCC authority is automatic; no test reports are required to prove the device will not harm the RF environment. Millions of

AM-FM receivers are authorized for sale without a single shred of technical data ever being submitted to the FCC. Compare that with the mounds of tech-

---

*There is a class of devices for which no application is submitted to the FCC. Instead, the manufacturer simply states it has produced a device that complies with the FCC rules.*

---

nical information that a radio common carrier must submit to support a license application for a single 20W base station, for example.

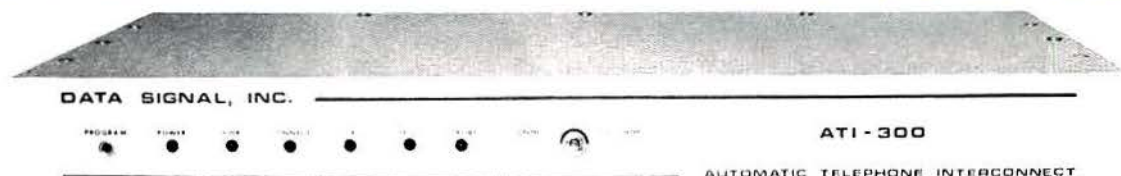
When this quasi-laissez faire regulatory approach is applied to the automobile's cramped radio spectrum environment, the burden falls on industry to resolve RF emission and RF interception problems.

Radio dealers need to develop a keen appreciation of the RF environment in which the equipment they sell will operate. A greater knowledge of the interaction between electronic devices in the RF environment is becoming more and more important in selecting equipment for inventory and sale.

Greater expertise in electronic diagnostic techniques to overcome customer complaints about malfunctions caused by excessive RF emission or RF interception soon may be required. Merely substituting one brand of equipment for another in a customer's car may not solve the problem.

Two-way radios, pagers and mobile telephones may no longer be rated by receiver sensitivity alone. Instead, manufacturers may need to concentrate on selling the notion of their receivers' pro-

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tection against undesired signals from consumer devices and computers, too.

Greater efforts in providing information to customers may be required so a driver is made aware of his RF environment. Without the driver's cooperation, FCC regulations directed at the operation of RF devices is wasted on uninformed and mystified customers.

The FCC must do more to protect ra-

dio dealers and customers. Although most manufacturers of electronic devices may design equipment to meet the challenges of the RF environment, without FCC intervention, a few sharp operators can create havoc on that environment. Money to be made in consumer electronics is too attractive to expect the trend toward marketing improperly manufactured and illegal RF

devices to reverse unless the FCC provides effective rule enforcement.

Commercial aircraft communications equipment manufacturers offer an example of manufacturing techniques that have overcome RF interception problems. Such equipment includes more metal and less plastic, shielded cable and shielded connectors. Critical signal leads are filtered. Wide, braided grounding straps eliminate voltage differences between units.

RF device and auto manufacturers should take the following steps to improve vehicle safety and reliability in the RF environment:

(1) Require subassembly manufacturers of electronic controllers to shield cabinets, cases, connectors and cables. Specify low-pass feed-through filters and ferrite beads on each signal lead and dc supply line.

(2) Provide zipper-closure metal conduit for all signal and dc leads to and from the controlled device and back to the centralized electronic controls.

(3) During the vehicle's mounting and assembly, provide a grounding path between components. Investigation of RF interception incidents reveals metal tie down clamps are painted on the inside. Paint insulates the connection, the opposite of the desired effect.

(4) Provide a low-impedance grounding path across hood hinges, engine mounts, hood latches, hood guides, all subassemblies and the microprocessor system.

(5) Insist that suppliers and manufacturers of electronic fuel-injection equipment, microprocessors and other electronic accessories supply products that are not susceptible to RF interception. Institute procedures to test and inspect the products to prove they meet the requirement.

#### Cooperation

As time goes on, the 7-foot by 5-foot space that makes up the interior of the average American auto will continue to be the most congested RF environment in the country. Industry and government should cooperate in taking steps to keep this vital RF environment safe and functional for consumers. In this way, everyone can continue to benefit from the continuing advances that radio communications technology will bring.



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# How analog scrambling fits tactical security needs

*Various analog scrambling methods offer opportunities for two-way radio communications system operators to prevent eavesdropping. Scrambling adequately protects most commercial and public safety communications.*

By Don Bishop  
Editorial Director

Analog scrambling helps commercial repeater operators to serve more users and helps public safety agencies to protect tactical communication. "Tactical communication" has little or no value hours or days after it takes place. Thus, scrambling methods that require a lot of time to decode adequately protect tactical communication.

Radio communications service providers generally avoid placing competing users on the same community repeater. Competitors might be tempted to monitor each others' radio traffic, a maneuver that leads to dissatisfaction with the radio service.

## Preventing eavesdropping

Public safety radio communications system operators need to prevent eavesdroppers from hearing certain communications during tactical operations, though if the information were decoded at a later time it would be useless to an eavesdropper. Typically, the eavesdroppers include suspects, reporters and radio listening enthusiasts who might be drawn to the scene of action.

Doug Thomson, manager of OEM sales for MX-COM, Winston-Salem, NC, explained some of the analog scrambling methods. He emphasized that his discussion does not include digital scramblers.

• **Masking tones**—"You can insert a tone, typically at 1kHz, so a listener hears a tone and not the voice," Thomson said. "At the receiver, a notch filter eliminates the tone. But the masking

## Analog scrambling methods

- ☐ Masking tones
- ☐ Inversion
- ☐ Rolling code
- ☐ Variable split band
- ☐ Time permutation

tone method is not commonly used because it takes up so much of the modulation level to transmit the signal."

Multiple notches can be used to allow the masking tone frequency to change periodically. But even then, the scrambling is easy to defeat.

• **Frequency inversion**—"Simple frequency inversion uses a fixed carrier and inverts the audio so all the frequencies are upside down," Thomson said. "This gives you security and privacy at a low level, but it is easy to defeat. Anyone who is familiar with the technique and who has rudimentary equipment can decode it. But the FCC has fairly strict laws to protect private communication. A person who intentionally decodes scrambled communication is subject to penalties."

Thomson said simple inversion may be adequate for shared repeater applications to give competitors some privacy.

• **Rolling code**—When the carrier frequency of an inversion scrambler is

made to change—to "roll"—the inverted audio shifts from one carrier code to another and becomes more difficult to decode. A communications radio's bandwidth limits the choice of inversion carriers to a range between about 3kHz and 3.6kHz. Within that range, only a finite number of carriers are useful.

"For example," Thomson explained, "if you begin with a 3kHz carrier and shift it to 3.001kHz, the second frequency is so close to the original it is not a useful shift. The carrier must be moved at least 100Hz to 150Hz for the frequency shift to render speech unintelligible."

When the carrier is shifted, the decoded audio's frequency response narrows. At extreme carrier frequencies, the decoded audio becomes too bassy or too tinny to understand. "Because of that," Thomson said, "the theory says there are only about four useful carriers you can use for a rolling code scrambler."

## Parallel listening

With what is known as a parallel listening technique and multiple decoders set to in-band frequencies, a trained listener can understand encoded rolling-code scrambled audio.

"With a rolling code scrambler, because you know the carriers have got to be between 3kHz and 3.6kHz, you put four fixed inverters at about 3kHz, 3.2kHz, 3.4kHz and 3.6kHz with parallel speakers in a semicircle in a room. The listener is able to hear which speaker has the correct audio. It takes some talent and it takes some doing, but it can be done," Thomson said.

• **Variable split band**—A refinement of the rolling code scrambler splits the



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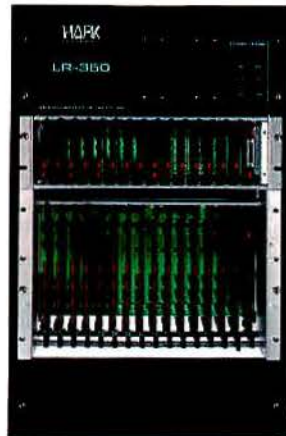
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audio spectrum into two basebands. Each baseband is scrambled with a rolling code and then recombined. "Variable split band scrambling gives a little more security than the standard rolling code scrambler," Thomson said. "Even if you were to do a parallel listening test, the audio is again chopped up. It gives you a little more security and from what we have read and from experts we have talked to, it is about the highest level of security you can achieve without adding time permutation."

Thomson said all frequency domain scrambling of the types described so far have a similar problem: "The tempo of the speech is not changed. Where you put emphasis and where you pause is not changed. It is contended that inverted speech is just like a foreign language, that it can be learned." An alternative is time domain scrambling.

• **Time domain**—With time domain scrambling, various segments of audio are recorded, shuffled and recombined in a new sequence. "With time domain scrambling you must have some kind of

*'... time delay scrambling is not widely used.'*

synchronization so you know where the segments begin and end," Thomson said. "If you fall out of synchronization, you lose intelligibility. With time domain scrambling you can get extremely secure transmissions, especially when you start getting segments a second or longer."

#### 'Shuffling' delay

Time domain scrambling has not been used widely because until recently, the hardware required to implement it has been too expensive. Applications outside of half-duplex two-way radio—telephone, for example—do not lend themselves well to time domain scrambling because it delays speech by about two seconds. Shorter delays are possi-

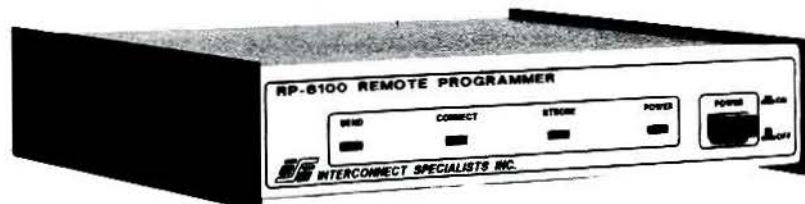
ble, but they sacrifice security. "The shorter and shorter you get the time sequences that you shuffle, the more intelligibility comes back," Thomson said. "You reach the point where you now are involved in subtime portions of the syllables. If you get them too short, under about 16ms, you are not really doing anything. You need to get them longer, about a second or so. When you do that, you have to record the time for a second and shuffle it."

"At the receive end it has to be recorded again and unshuffled. So you end up with a time delay of two seconds before someone hears the decoded audio. You have a terrible time lag. People do not like the delay, so time delay scrambling is not widely used," Thomson explained.

Mobile radio system operators who need to provide a measure of privacy can choose from a wide variety of scramblers made by many manufacturers. A list of scrambler suppliers appears on page 70 of the December 1989 issue.



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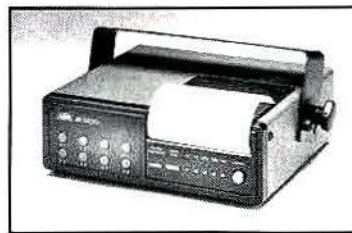
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Circle (382) on Fast Fact Card



## New Cellular On-Glass Temporary Mount from A/S

A "take-off" on Antenna Specialists famous 3dB gain on-glass cellular mobile antenna, model XPD80 utilizes the same high performance technology in a temporary window mount. Unique "clip-grip" window clip clamps the antenna tightly to car window; cable remains inside. Fully compatible with future digital cellular systems.

Circle (372) on Fast Fact Card



## Miniature Modules

ANI; CTCSS; DCS; scrambling; encryption; digital signaling; analog signaling; five-tone; two-tone and DTMF. Modules are compatible with most popular formats including Motorola, General Electric, RCA, Reach, Coded, ZVEI, CCIR, EEA and other systems.

Transcript International

Lincoln, NE; 800-228-0226.

Circle (415) on Fast Fact Card



## Page Sitter

No more missed pages!

- Tracks more than 32,000 digital pagers.
- Stores individual files.
- Records time and date stamp, capcode function code, pager type & data message.
- Automatic decode NEC, Golay, Pocsag 512/1200 synch 1-4.
- Instant retrieval local or remote.

Statistical Control Systems

813-954-8816

Circle (385) on Fast Fact Card



## PiRod Tower Spec Guide

Tower Specification is created to help buyers evaluate and select all types of guyed and self-supporting towers and the options required to meet their needs. PiRod, P.O. Box 128, Plymouth, IN 46563; 219-936-4221.

Circle (380) on Fast Fact Card



## Midland Syn-Tech XTR Mobile Radios

Midland LMR's economical new high performance Syn-Tech XTR two-way mobile radios are 30% smaller than previous models and meet MIL specs for ruggedness. Programmable for up to 22 or 99 VHF or UHF channels with channel scan, voice storage and voice security options.

Circle (373) on Fast Fact Card



## 45W RF Power Amplifiers

Decibel lets you increase cell density without adjacent cell interference. Lower prices, volume discounts and immediate delivery are offered on its 45W dynamic power amps. They are drop-in interchangeable and used by AT&T for Autoplex cell sites.

Circle (369) on Fast Fact Card





### Touch-To-Talk

Color touchscreen console systems from **Avtec** are fully integrated, non-blocking, radiotelephone dispatch console systems for public safety, utilities, airlines, railroads, military and other government agencies.

Circle (374) on Fast Fact Card



### Interconnect Specialists' Automatic FX Line Selector

The AFX-3200 provides automatic selection of one of four telephone lines, as determined by the first three digits of the telephone number dialed. All 640 exchanges can be assigned to any of the lines. All telephone lines can be shared by any number of interconnects and AFX-3200s. Interconnect Specialists, 1215 N. CR 427, Suite 105, Longwood, FL 32750; 800-663-3750.

Circle (364) on Fast Fact Card



### SMC Electro-Mount

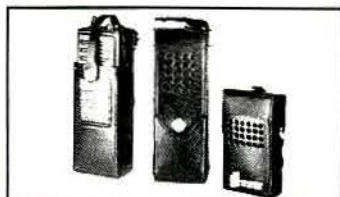
Providing the communications industry with the widest variety of quality installation hardware in the world.

"Custom installation without fabrication."

P.O. Box 1607, Tomball, TX 77377

800-527-1079; Fax 713-351-0718.

Circle (384) on Fast Fact Card



### Leather Cases for Portable Radios & Pagers

Made of the finest, full-grain leather, specially developed by **Leathersmith** to repel moisture and resist scuffing, these sturdy cases feature strong nickel-plated snaps and fasteners. Optional quick release swivel mounts are available for all models.

**Leathersmith** 800-233-0440.

Circle (379) on Fast Fact Card



### A Whole Tradition of Innovation in One Catalog

Phone 800-288-2763 to order your copy of **Sinclair's** 1990 catalog.

Circle (386) on Fast Fact Card



### CAD System

**Midian Electronics'** CAD modem and software provides system and unit ID; 10 status conditions; 100 locations with time and date; and selective calling. Entries can be edited as they appear and logged to files, disk or printer. Available in DTMF, two-tone, five-tone and digital formats.

Circle (367) on Fast Fact Card



### Microwave Systems Brochure

**Cardion Electronics'** new product brochure includes specifications and photographs of typical installed systems and equipment, including analog terrestrial microwave and direct-to-line CCITT compatible voice multiplex with data capability of up to 19.2 Kb/s. Complimentary copies are available for users, prospective users and consultants.

Circle (366) on Fast Fact Card



### KBC-8000 Desktop Controller

- Controls up to 8 Kyodo 16-channel base and repeater stations.
- Base and repeater mode switching, phone patch, cross channel/broadcast capability.
- Dual speakers, quartz clock, electret microphone and logging recorder jack.
- Optional DTMF and two-tone keypads.

Contact **Kyodo West** 800-535-2082.

Circle (375) on Fast Fact Card



### DTMF Mobile Encoder ME-400

**Data Signal's** mobile encoder:

- Full size backlit tactile keyboard.
- Tone output selectable between continuous or precision timed.
- Automatic PTT and mic muting.
- Sidetone monitor.
- Transmit ready light with safety timer to reset hung PTT.
- Subminiature size.

Data Signal, 2403 Commerce Lane, Albany, GA 31708; 800-652-9296; 912-883-4703.

Circle (363) on Fast Fact Card



# Product/Services Showcase



## UHF Broad-band Antenna

**Sti-Co's** EF-450 disguised two-way antenna covers 20MHz within the 406MHz-to-512MHz frequency range. It looks like a cellular elevated-feed antenna. The EF-450 fits most cars and is easily installed either permanently or as a loaner. Available in trunk lip, magnetic or roof mount.

Circle (381) on Fast Fact Card



## Powerful Palm-Sized Two-Way Hand-Held Radio

The Eclipse 5W, 4-channel two-way radio is a technological breakthrough in miniaturization. Comes with NiCd battery; 6" antenna; wall charger; soft case; belt-clip; and 1 itinerant frequency. **Advanced Videotech** 800-233-0013; 215-322-4600.

Circle (378) on Fast Fact Card



## MF-960B Miniflector

**Scala's** MF-960B miniflector qualifies for FCC rule section 94.75, category B, when it is vertically polarized. The antenna is supplied with mounting hardware for 2-inch pipe, and it is broadband 940MHz to 960MHz.

Circle (368) on Fast Fact Card



## MX-COM's Scrambled P50

The MX P1086 encodes and decodes 38 Radius P50 "PL" tones, protecting speech with Pvt SQUELCH, CTCSS-controlled speech inversion. Great for repeaters, easy to use. Ask your Radius supplier or call MX-COM, 800-638-5577.

Circle (365) on Fast Fact Card



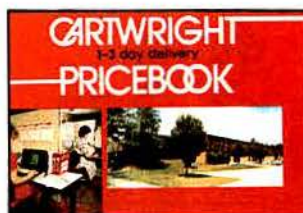
## Schlumberger's 4031

4031 features include:

- Portability/cellular capability.
- Duplex demodulator.
- Off-air measurements.
- Program storage.
- High-resolution zoom graphics.
- 1,000MHz spectrum analyzer.

Call 800-225-5765; 617-229-4825.

Circle (377) on Fast Fact Card



## Cartwright Catalog

Get your free copy of **Cartwright's** latest price catalog. We stock Antenna Specialist, Celwave, Decibel Products, Andrew and Cablewave cable, Bird, Astron, SSC, Selectone, Federal Signal, Alexander, Multiplier and many other fine lines.

Circle (296) on Fast Fact Card



## Crystal Cross Reference Book

This convenient cross reference book published by **International Crystal Manufacturing** lists most currently produced land mobile equipment. Manufacturer's crystal part numbers are referenced to ICM catalog numbers. Price codes are included. A great time-saver for ordering land mobile crystals.

Circle (376) on Fast Fact Card



## Dispatch Consoles

**Positron's** TRCC integrates the call accelerating features of an electronic key telephone system with the complete capabilities of a radio remote controller. Each console can handle any combination of telephone and radio circuits up to 240 lines.

Circle (395) on Fast Fact Card



## Low-Loss Cable Compatible With RG58 Connectors

UltraLink cable from **Cushcraft/Signals** installs easily and features low-loss characteristics. It is compatible with RG58-sized connectors. P.O. Box 4680, Manchester, NH 03108; 800-258-3860; Fax 603-627-1764.

Circle (403) on Fast Fact Card

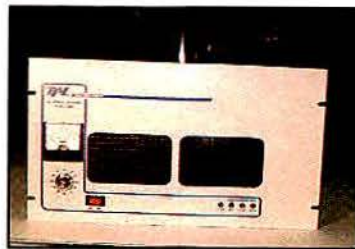




### Bee's 1990 Catalog

**Bee's** hand-crafted genuine leather cases are available for portable radios, pagers and test equipment. Cases for the most popular models, always in stock and most orders shipped the same day. Send for your free 1990 catalog today! Bee Electronics, 2655 Gardner Rd., Broadview, IL 60153; 800-336-3115.

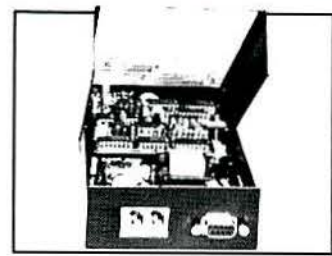
Circle (398) on Fast Fact Card



### Power Amplifier Series by TPL

These four new units provide the high power required for paging, repeater and base stations. The UHF and lowband units deliver 300W; the VHF highband units deliver 250W or 500W; and the 800MHz-900MHz units provide 200W.

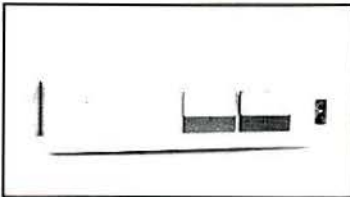
Circle (410) on Fast Fact Card



### TIC-1D Controller

The TIC-1D from **Northern Controls & Communications** is a low cost, high performance controller that effectively operates most end-to-end telephone equipment when interfaced to a duplex radio. It operates on multi-user systems and provides automatic ANI; ring, busy, fast busy; monitor lock; and CTCSS encode-decode.

Circle (389) on Fast Fact Card



### 48V-to-24V Dc-Dc Converter

**Wilmore's** low-profile model 1561 converter provides an isolated, adjustable 24Vdc output at 30A in only two rack spaces. Multiple converters can be paralleled for redundancy and additional power or both. Applications include powering microwave and FDM systems in central offices and other 48Vdc telecommunications sites. Shipped from stock.

Circle (388) on Fast Fact Card



### Polyrod

Copper-clad steel chemical ground rod makes a good ground in poor soil. Collects precipitation and can be fed via hose connection. UV stable salt container in tan or green. CuSO<sub>4</sub> and MgSO<sub>4</sub> replaceable salts 10 lbs.; 0 ft., 4 ft. or 8 ft. lengths. Hammer cap provided. Contact **PolyPhaser** at 800-325-7170.

Circle (390) on Fast Fact Card



### Replacement Batteries

**W & W Associates** announces additions to its expanding cellular replacement batteries for Motorola Flip-phone, both standard, slim line and battery eliminator; replacement battery and eliminator for the NEC P-300 series; and replacement battery and eliminator for the Nokia-Mobira P-30 cellular phone. W & W Associates, 29-11 Parsons Blvd., Flushing, NY 11354; 800-221-0732.

Circle (412) on Fast Fact Card

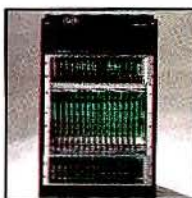


### Low Cost ANI

The ID-27 is **Control Signal's** new ANI encoder. Its small size (2" x 3") allows it to fit inside most mobile radios. It sends an ID when PTT is closed and again when released. Includes emergency input for silent alarm. Sure to stop the channel abuse.

**Control Signal**, 800-521-2203

Circle (413) on Fast Fact Card



### SI 550 EX

- Each mobile has its own 7-digit direct-dial number.
- Unanswered calls may be forwarded to another number.
- Works with SMR and interconnected conventional repeaters.
- Capable of handling 15 DID trunks.
- Can allow co-located systems of the same or different manufacturers to share the same DID trunks.

**Hark Systems**, 800-FOR-HARK

Circle (397) on Fast Fact Card



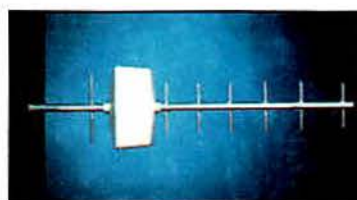
### Maxon Synthesized Mobile Radio

**Maxon Electronics** introduces the SM-4150, a 40W, PLL synthesized VHF mobile radio with 16-channel capability, CTCSS and DCS signaling systems compatibility. A fast scan function includes dual-level priority scan — all controlled by the SM-4150's microprocessor. The unit has a die-cast aluminum chassis that is lightweight, yet extremely durable and simple to install.

Circle (234) on Fast Fact Card



# Product/Services Showcase



## Celwave Yagi Antenna

The PD10108 is a rugged 9-element, 10dB yagi specifically designed for 806MHz-to-960MHz control station operation. Constructed of 6061-T6 solid aluminum rod, its director and reflector elements are precision-welded to the main boom to eliminate misalignment problems during shipping, installation and service. Celwave, Route 79, Marlboro, NJ 07746; 201-462-1880.

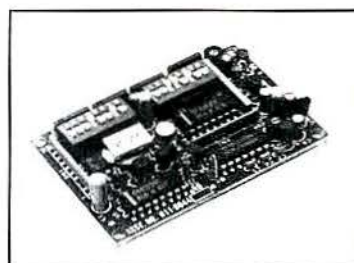
Circle (408) on Fast Fact Card



## Haewa 'HOS' Series Portable Radios

Features include: synthesized solid-state design with die-cast aluminum frame; 16-channel capability; scan; tone; T.O.T.; low-high power VHF 5W, UHF 4W; wall and drop-in chargers; and other accessories available. Haewa Communications, 404-921-3272; Fax: 404-921-2896.

Circle (370) on Fast Fact Card



## DTMF ANI encoder

Model E-718 DTMF ANI encoder from Vega Signaling transmits a three- or four-digit DTMF message upon command. It boosts adjustable digit rate, adjustable-delay PTT output and adjustable output level.

Circle (396) on Fast Fact Card



## CES Introduces New Auto-Dial Handset

The 860 handset may be configured to the requirements of the individual system. It features eight 21-digit memory locations; two 21-digit ANI locations; store and send; fourth column tone generation; variable dialing speed; on-hook and off-hook ANI; and keypad programming.

Circle (393) on Fast Fact Card



## Orbacom's Calinda Console

The Calinda is a compact microprocessor based, desktop dispatch center and is self-contained (no central package). It has a 16-channel capacity with a multifunction internal paging and signaling encoder and is fully user-programmable. Dealer inquiries welcome. Orbacom Systems, 1704 Taylors Lane, Cinnaminson, NJ 08077; 609-829-4455.

Circle (406) on Fast Fact Card



## Give Batteries New Life

Through recent advances in electronic technology, Alexander Batteries has condensed battery maintenance to a single piece of equipment, the Optimizer. In one-, three-, or six-unit models, the Optimizer is the industry's first voltage and capacity maintenance testing instrument for NiCd batteries.

Circle (404) on Fast Fact Card



## DTMF Hand-Held Mic

The 885TT DTMF hand-held mic from Shure Brothers sets new standards for quality and economy. The mic can be used with all vehicular radios with telephone interconnect. Key features include positive tactile-feel keys, illuminated keypad and externally adjustable DTMF and audio levels.

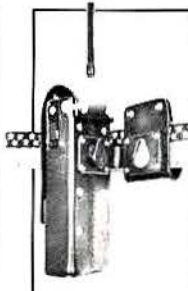
Circle (407) on Fast Fact Card



## New from VoCom/RF

VoCom/RF introduces Ultra Silver amplifiers designed for the extremely high-duty cycles and severe environmental conditions encountered by high-power RF amplifiers. Available from 35MHz-to-975MHz, they are completely immune to damage from external stimuli. Ultra Silver amplifiers carry a two-year warranty. Call 800-USA-MADE.

Circle (392) on Fast Fact Card



## Carrying Cases Protect Instruments From Damage

A.W. Enterprise uses advanced construction techniques; durable 8-ounce leather; nylon thread; and stainless-steel hardware to manufacture custom protective cases for electronic devices and two-way radios. The company's new address is 6543 S. Laramie Ave., Bedford Park, IL 60638; 800-334-4884.

Circle (399) on Fast Fact Card

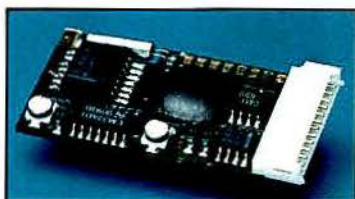




### FM/AM-1600S Radio Communications Service Monitor

A large color CRT displays all information necessary to test an RF transmitter or receiver. Meters are displayed in digital and trend format. The RF system has AM, FM and PM modulation capabilities. Independent RF generator and receiver allow offset frequencies up to 1GHz for applications. **IFR Systems**, 10200 W. York St., Wichita, KS 67215; 316-522-4981.

Circle (401) on Fast Fact Card



### Model ST-150

- Compatible with both DCS and CTCSS formats.
- Measures only 1.68"L x 0.85"W x 0.20"H.
- Designed for both portable and mobile applications.
- Includes Xmit limit timer with "penalty box."
- Includes busy-channel-lockout.
- Five-year warranty.

**Selectone**, 800-227-0376.

Circle (402) on Fast Fact Card



### Omni Computerized Mobile Radio Systems

Omni series solid state, modular, high-end, computerized radio systems include the IQ1000VHF (148MHz-to-174MHz); IQ1000 UHF (450MHz-to-480MHz) and IQ2000 covering both bands. IQ1000 units provide up to 512 channels in 16 groups, and the IQ2000 is capable of 1,024 channels in 32 groups. **Teletec**, P.O. Box 20405, Raleigh, NC 27619; 919-556-7800.

Circle (394) on Fast Fact Card



### DS-10 Laptop Mount

**Gamber-Johnson's** lockable laptop mount head provides secure hardware for ergonomically convenient positioning of laptop computers in police, fire, EMS, service, sales or fleet vehicles of any size or type. Key locks provide security and allow for easy removal when you need to take your laptop with you.

Circle (409) on Fast Fact Card



### E.V.A. Cable Ties

E.V.A. coated stainless-steel cable ties are quickly and easily tensioned to their optimum holding power with a new cable tie tensioner from **Band-It**. Reusable E.V.A. cable ties are chemical and weather resistant, halogen-free, non-toxic and are available in many lengths and colors.

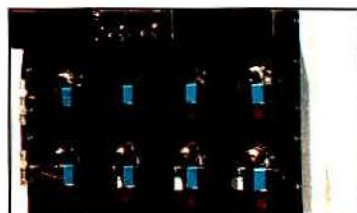
Circle (411) on Fast Fact Card



### SCA Announces Shinwa's Y Series Mobile Radio

This small 25W output radio has a 20MHz broadband channel spread. It is designed with two separate CPUs to allow remote mounting of the control head and is programmable via the microphone connector. Standard programmable signaling features are 5-tone, CTCSS and single-tone.

Circle (383) on Fast Fact Card



### Rural Telephone Combining and Receiver Distribution

Designed specifically for the rural telephone market, the unique construction allows all components to be tuned from the front of the rack. The compact design requires only 17.5" of rack space for full eight-channel receiver and transmitter capability.

**Telewave**

Circle (391) on Fast Fact Card



### Toshiba Laptops Increase Productivity

Toshiba's T1000XE and T1200XE laptops suit users who need portability and desktop performance. Both units are truly functional notebook-sized PCs with 20MB drives and 1MB RAM. The T1200XE includes 286 processing and a 1.4MB floppy drive. **Tessco** also carries a full line of computer accessories designed specifically for laptops.

Circle (371) on Fast Fact Card



### Bomar's GE MPI Crystal Bank

**Bomar** announces GE MPI crystal bank with a selection of more than 300 frequencies. Three to five day turnaround for crystals on the bank list. The high performance crystals carry a lifetime guarantee. Call for crystal bank listing and special pricing, 800-526-3935; 201-356-7787.

Circle (362) on Fast Fact Card



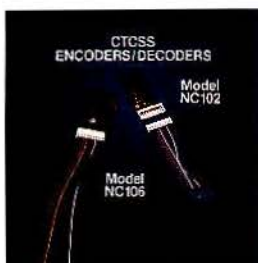
# Product/Services Showcase



## High-Power Lowband Mobile

The RML60 is a 45-channel, 60W low-band mobile radio from **Relm Communications**. With track tuning, it covers 30MHz-to-50MHz in two versions. Other features include an instant priority button; area scan; and built-in CTCSS and DCS, both standard and inverted.

Circle (405) on Fast Fact Card



## Well Connected

CTCSS encoders and decoders; smaller sized with wires housed in connector plugged into PCB header. Competitively priced. Both field-tunable or dip-switch programmable. Call or write today for pricing and full specifications.

**Norcomm**

800-874-8663; CA: 916-477-8400

Circle (400) on Fast Fact Card



## Free Literature

**Unipage** manufactures a complete line of paging systems and products. These range from a small, highly efficient terminal for small, dedicated paging applications to large networking systems with millions of subscribers and complete redundancy. Unipage, 1509 Falcon, DeSoto, TX 75081; 214-224-3509; 800-367-2864.

Circle (416) on Fast Fact Card



## Antennas and Batteries For Radios and Phones

Product guide presents supplies for communications and other electronic gear. Discover many antennas, batteries, battery packs and accessories for radios, pagers and cordless telephones. **Centurion International**, P.O. Box 82846, 3425 N. 44th St., Lincoln, NE 68501; 800-228-4563.

Circle (418) on Fast Fact Card



## Scattered Radio Systems Linked Into Single Network

Large utility companies are using **Zetron's** radio dispatch switches to integrate multiple radio systems into a single communication network.

**Zetron**, 206-820-6363.

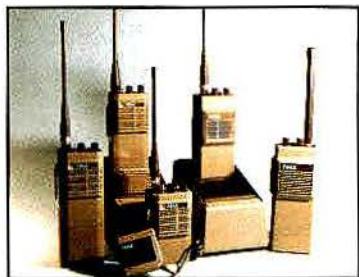
Circle (417) on Fast Fact Card



## Model 400 SWR/Field-Strength Meter

New from **CT Systems**, this portable, battery-powered unit allows a user to test antenna SWR over the 800MHz-to-1GHz range. By adding an antenna to model 400, a user can measure relative transmitted power over the entire land mobile range to 1GHz. Call CT Systems at 800-245-6356; 317-787-5721.

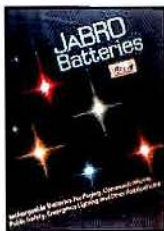
Circle (419) on Fast Fact Card



## 5W, 6-Channel Hand-Held

**Tekk's** fast-growing product line now includes a 5W, 6-channel hand-held. The die-cast frame promises a rugged, heavy-duty extension of its popular line of low-cost LMR products. Call your distributor or Tekk, 816-455-1555.

Circle (414) on Fast Fact Card



## Rechargeable Replacement Batteries

A revised catalog featuring nickel-cadmium and sealed lead-acid batteries for two-way radios, pagers, emergency, and security lighting, and other applications is available. More than 200 batteries are listed, with many illustrated and cross-referenced to simplify ordering.

**JaBro Batteries**, Lisle, IL 60532.

Circle (226) on Fast Fact Card



## Hand-held Programmer for IC-110

Designed for field programming of **Communications Specialists** IC-110 tone signaling microcircuit, the hand-held programmer allows technicians to change tone memory to provide non-standard DIP switch tones, plus allows other special applications; operates on 9V battery (provided); small size for easy portability; one-year warranty; price: \$199.95.

Circle (289) on Fast Fact Card



## Kustom selling assets of traffic safety division

Kustom Electronics, Overland Park, KS, in a move to concentrate on the rapidly expanding mobile data communications marketplace, signed a letter of intent with Triax International for the purchase of the company's traffic safety division.

A week following of the announcement of the intent to sell, Kustom's stock rose 8.6%. The proposed sale is subject to contingencies, including third party and regulatory approvals.

## Association offers sales, marketing seminars

In an effort to provide mobile radio professionals with advanced sales and marketing techniques, the National Association of Business and Educational Radio (NABER), Alexandria, VA, is offering ongoing educational seminars.

The seminars cover prospecting and targeting markets and building an effective sales team. Lead by instructor Ber-

## GTE to distribute METS product, services

METS, Indianapolis, and GTE Mobile Communications, Houston, agreed to a distribution and marketing pact calling for GTE to distribute METS' stolen vehicle recovery network products and services. Terms of the deal were not disclosed.

GTE will sell, install and service METS; products and services through its nationwide marketing and distribution channels.

nard Petrina, president of Executive-management Renewal Programs, Harrisburg, PA, seminars are limited to 45 people and are open to members and non-members. The cost to members is \$165, and it is \$195 for non-members.

For more information on the seminars, contact Elizabeth Welsh at 800-759-0300.

## Sti-Co builds facility

Sti-Co Industries is expanding its operation with the construction of a new complex in Orchard Park, NY. The facility will enable the company to increase its production of lowband, high-band and UHF antennas.

## A. W. Enterprise moves

A. W. Enterprise has moved to a larger manufacturing facility. The company may be reached at 6543 S. Laramie Ave., Bedford Park, IL 60638; phone 708-458-8989, 800-334-4884; fax: 708-458-9023.

## ARDIS commences operation of radio data service

ARDIS, Advanced Nationwide Radio Data Information Service, the joint partnership of two well-know American companies—Motorola, Schaumburg, IL and IBM, New York, commenced full commercial operation of its nationwide radio data network service.

The newly formed company, based in Lincolnshire, IL, integrates IBM's nationwide private radio data system and

Motorola's shared use radio data network. It accommodates 24-hour service in more than 8,000 U.S. municipalities and towns. Otis Elevator Company, Sears, Roebuck and Company's Product Services and New York Life Insurance are among the first U.S. companies to test the ARDIS system.

Financial details of the company were not disclosed.

## Radio leagues seek computer network papers

Aug. 6 is the deadline for camera-ready papers for the ARRL/CRRL Computer Networking Conference. An author's package is available from Lori Weinburg at ARRL, 225 Main St., Newington, CT 06111.

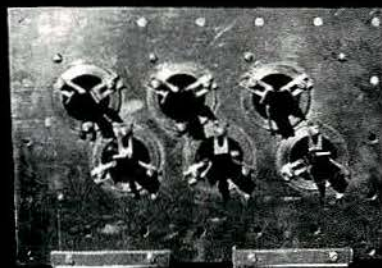
Topics will cover HF packet investi-

gations, packet satellites, network development, hardware, protocols, software, packet services and future systems.

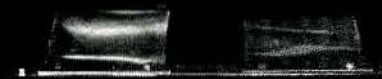
The conference is set for London, Ontario, Sept. 22.

# NEW

## GROUND COAX ENTRANCE PANELS



- Easy Installation
- Weatherized Ports
- 1/2" to 1 5/8" Coax
- 1/8" Half Hard Copper
- 6, 12, 18 and 24 ports
- Universal Protector Mounting pattern
- S.S. Hardware throughout
- Two 10' long 6" wide copper grounding straps
- Ground Sandwich Bus for Perimeter connection



Over 450 models to solve your  
LIGHTNING PROBLEMS

## KPolyPhaser

2225 Park Place  
P.O. Box 9000  
Minden, NV 89423-9000  
(702) 782-2511 • (800) 325-7170  
FAX: (702) 782-4476



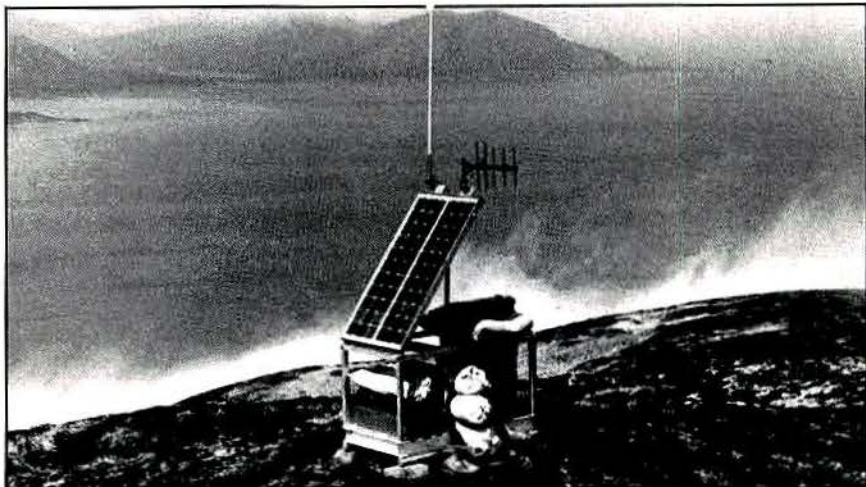
### Portable repeater stations aid oil clean-up effort

Communications equipment proved essential to 11,000 people, 1,500 vessels and 84 aircraft operating over thousands of square miles of Alaskan waters last summer in what might be the largest assemblage of telecommunications equipment and personnel in an oil cleanup.

Many communications companies aided in the massive cleanup program implemented in Prince William Sound from the Exxon Valdez oil spill.

IWL Communications, Houston, was among the communications companies that worked with Exxon officials to provide communications solutions for the clean-up effort. The company custom-designed its rapidly deployable radio repeater stations to extend Exxon's off-shore and inland communications during the clean-up.

The repeater stations included self-contained photovoltaic power, as well as power and radio systems housed in weatherproof enclosures. Once on site, the stations could be set up and operat-



Photovoltaic arrays power repeater stations that are part of the Exxon Valdez oil clean-up communications system. This repeater station is installed at East Kodiak Island, AK.

ing in less than 20 minutes.

Each station included three repeaters, each programmed for single channel operation and broadcasting a low-power synthesized RF signal through an om-

nidirectional fiberglass antenna. Built-in crossband repeaters linked the Exxon Kodiak Command Center with clean-up vessels equipped with VHF marine radios and shore stations.



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### Swiss PTT aligns with Schaefer Associates

K. Schaefer and Associates, an international telecommunications consulting company based in Washington, DC, represents the Swiss PTT in North America under an agreement reached in March. The appointment signifies the first presence of a Swiss PTT outside of Switzerland.

### Radio Call acquires 8 Nynex IMTS channels

Radio Call, Melville, NY, has acquired eight UHF IMTS channels from Nynex paging company. The acquisition was in association with MRN Communications, a Melville-based electronic paging company and FCC-licensed radio common carrier. Terms of the deals were not disclosed.

With the purchase, Radio Call can provide uninterrupted paging coverage throughout the Northeast corridor. The company plans to dedicate one channel to alphanumeric paging.

### Energy Innovations acquires rights to MARS-Link

Energy Innovations, Dayton, Ohio, has acquired the rights to MARS-Link, a multiple address radio system, from

TFT, Santa Clara, CA. Energy Innovations designs and develops products for the utility industry.

### Public safety coordinators to share common database

The American Association of State Highway & Transportation Officials (AASHTO) and the Association of Public-Safety Communications Officers (APCO) agreed to exchange computerized information and cooperatively update their data files.

The two coordinators will share in the expense of updating a common database to conform to the FCC's Part 90 license records, and will make it possible for their respective local advisers to view pending applications and work-in-progress in all of the categories that they collectively serve.

The new agreement is designed to facilitate the work involved in the inter-service sharing of radio channels, which allows users in one radio service to

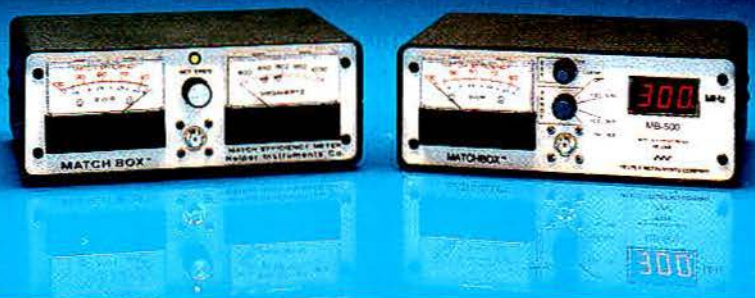
"borrow" frequencies available to users in another service on a local geographical basis, while preserving the benefits of the commission's "block allocation" system. It will also facilitate the "concurrency" procedures prescribed by the FCC's rules, which require prospective users of closely spaced channels to obtain concurrence of the coordinator serving existing users of the adjacent channels prior to recommendation of the channels for use by additional licensees.

Requests for AASHTO frequency coordination service are submitted to AASHTO offices in Washington, D.C. Requests for APCO services are submitted to APCO offices in New Smyrna Beach, FL.



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Circle (46) on Fast Fact Card



## Professional association membership adds value to technician's services

The Association of Communications Technicians (ACT) is continuing an active membership development program, according to John Sherlock, director of membership and communications for the National Association of Business and Educational Radio (NABER). ACT is a membership section of NABER.

Sherlock said ACT membership has been "holding strong," and that recruiting levels have been in line with the section's strategic goals.

The association plans to contact members who live near council meeting locations and invite them to attend. "We want to get more members involved by attending council meetings," he said.

### Membership 'churn'

Sherlock said membership "churn," the rate at which new members join and current members leave the association, is "well within expectations." He said because of the nature of ACT, its churn

rate probably is lower than that of many other associations.

Phyllis Walters and Maria Barnes, NABER membership service representatives, field more than 150 calls per day on behalf of ACT and the technician certification program. They administer the certification exam at the NABER headquarters when it is given there.

"I continue to hear everywhere there is a shortage of good service personnel. ACT helps alleviate the problem with technical sessions, by stimulating study for certification and through the involvement of its council by members such as Tom Green." (Green is a communications manager and electronics instructor at the Ranken Technical Institute, St. Louis.)

"The technician or student who is thinking about getting into other fields is going to ask, 'What's in it for me? Why should I do this instead of climbing telephone poles or repairing com-

puters?' Organizations such as ACT build professionalism for technicians. That benefits dealers and the users," Sherlock said.

"We believe the technicians are of critical importance to any service shop," he continued. "A professional organization can be helpful in communicating that to everyone. When that someone brings a defective radio into the shop, the technician is the hero who makes it work. A professional organization helps to increase the value of what the technician brings to the shop and to the industry."

### Information

For information about ACT and technician certification, call 800-759-0300. Ask for 'technician services.'



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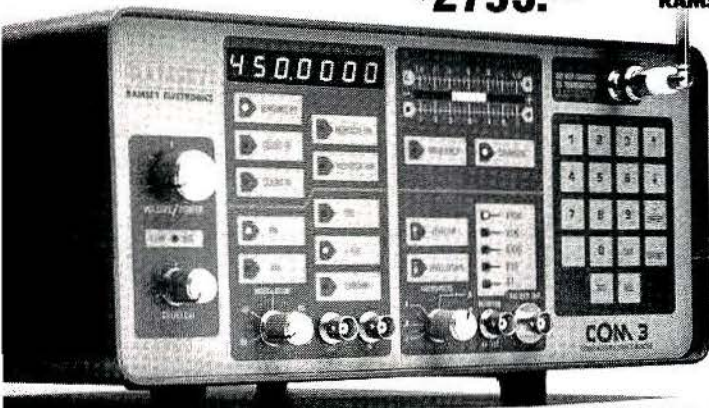
performance circuitry provides remarkable sensitivity for superb, high-resolution frequency analysis and observation. Interference location and characterization is easier than ever. Not only can you see the interference, you can hear it too. A variable bandwidth audio demodulator allows you to detect and audibly identify the interfering signals. In addition, a true frequency counter display speeds center frequency setting and reading. Frequency range covers the entire 1 MHz to 1000 MHz spectrum. Add the optional tracking generator and you can easily tune duplexers, filters and cavities!

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## SMR association draws fire with San Bernardino plan

Hoping to correct deficiencies it saw in an FCC plan to assign radio channels to San Bernardino County, CA, the American SMR Network Association (ASNA) petitioned the agency to modify the plan. The FCC intends to assign the county certain frequencies offset 15kHz from specialized mobile radio

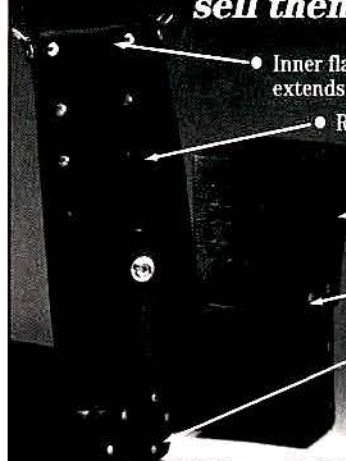
(SMR) channels. ASNA asked the FCC instead to give the county priority for public safety channels.

The County of Los Angeles' Internal Services Department and the Southern California 800MHz Regional Plan Revision Committee filed comments opposing ASNA's idea. ASNA seeks to

protect current SMR systems from interference and to avoid the establishment of public safety systems that thereafter would have to be protected by SMR systems built later. The department and the committee resist having to divert frequencies that could be used by other public safety entities to satisfy San Bernardino when the FCC plan meets their approval.


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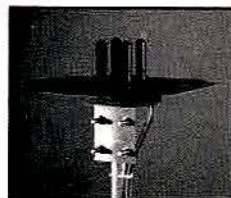
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## American Skycells asks FCC for air-to-ground spectrum

American Skycell, West Atlantic City, NJ, has asked the FCC to make available to it part of the radio spectrum the agency plans to set aside for air-to-ground telephone service. Skycell wants the FCC to split in two the four megahertz segment of radio spectrum reserved for commercial air-to-ground telephone communications. It wants half to be reserved for present technology and the other half reserved for advanced technologies, such as a technology developed by Skycell.

## Communications council asks for access to 900MHz band

The Land Mobile Communications Council (LMCC) has asked the FCC to designate the 901MHz-to-902MHz and 940MHz-to-941MHz bands for use by eligibles in the private land mobile radio services. These frequencies were designated for use by what the FCC named the General Purpose Mobile Service (GPMS) in 1986, but no GPMS service rules have been adopted.

## Kitchen decries increase in FCC paperwork filing

E.B. "Jay" Kitchen, president of the National Association of Business and Educational Radio (NABER), resents changes in FCC fees and paperwork filing requirements that will add an extra form to documents private land mobile radio license applicants must complete. The extra form would be used by Mellon Bank in Pittsburgh for its data entry process. The change will affect as many as 650,000 applications annually, at an estimated cost to applicants of \$2 million. The cost is figured on the basis of an extra 10 minutes to fill out the form at a rate of \$20 per hour.



## Public safety groups ask for medical radio service

The International Association of Fire Chiefs (IAFC) and the International Municipal Signal Association (IMSA) have petitioned the FCC to create an Emergency Medical Radio Service (EMRS).

The associations ask for 10 channel pairs in the 220MHz band to be set aside for EMRS.

## Utilities oppose Millicom's personal communications net

The Utilities Telecommunications Council (UTC) has filed comments with the FCC chief engineer about PCN America's application for frequencies for an experimental personal communications network (PCN). PCN America is a subsidiary of Millicom.

UTC opposes the application for spectrum in the 1.7GHz-to-2.3GHz band because of heavy utility company use of the 1.8GHz and 2.1GHz bands for fixed microwave.

## Federal Digital Cellular wants a third cellular band

Air-to-ground telephone service offered by GTE Airfone and proposed by the Goeken Group could be preempted if the FCC grants a request filed by Federal Digital Cellular (FDC) for a third cellular mobile telephone band. FDC wants the same 849MHz-to-

851MHz and 894MHz-to-896MHz frequencies that Airfone and Goeken want. FDC cited "an unhealthy concentration of control in the cellular industry" in asking the FCC to establish an opportunity for a third cellular carrier to enter each market.


## Land mobile council backs FCC decision about 220MHz

The 23-member Land Mobile Communications Council has moved to intervene in support of the FCC in the U.S. Court of Appeals case challenging the FCC's decision to allocate spectrum

in the 220MHz band to land mobile radio services. The decision has been appealed by the Amateur Radio Relay League and the Department of Justice.

## FCC seeks \$117.9 million for 1991 fiscal year budget

If Congress approves the FCC's \$117.9 million 1991 budget request, the agency will have \$10.4 million more to spend next year compared to this year. FCC chairman Alfred Sikes said the increase is necessary "to restore integrity to the

commission's overall regulatory enforcement responsibilities." For one, the agency proposes to expand its fleet of mobile automatic direction-finding vehicles that trace sources of interference and unlicensed signals. 

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Omni DSD™ DB812F offers 500 watt input, 12 dBd gain and .5° electrical downtilt in a rugged fiberglass radome. Other omnis offer up to 10 dBd gain and directionals to 17 dB gain with up to 800 watt input and optional 3°, 6° or 10° electrical downtilt.

#### RF Power Amplifiers

100 and 160 watt cellular amplifiers are offered now, and 200 watt amplifiers will be available in late 1990.

#### High Power Tx Combiners

Several Decibel combiners that combine 2 to 20 Tx as close as 250 KHz are designed to work with Decibel's RF power amplifiers, with maximum power inputs up to 150 or 200 watts per channel but limited to total outputs of 700 or 1200 watts per system.

#### Tower Top Amplifiers

These pre-amplifiers, used at the antenna terminal, improve Rx sensitivity and extend the "talk back" range for low power Tx.

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Circle (52) on Fast Fact Card

## New products

### Readers' choice

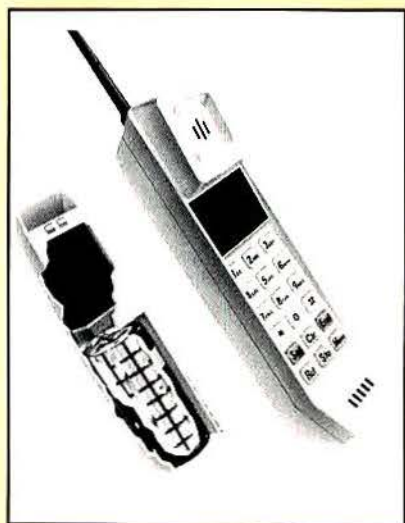
Of all the new products and services covered in the November 1989 issue, the ones reprinted here generated the most reader requests for additional information. If you missed them

the first time, here is your opportunity to acquire more information on them: Just circle the corresponding Fast Fact Card number on the Fast Fact Card found in the back of this issue and mail the card to us.

### Zinc-air battery supplements NiCds for two-way, cellular

NiCd Batteries, widely used to power portable two-way radio and cellular equipment, usually are recharged via charger units connected to ac power. Zinc-air cells developed by **Duracell** are intended to replace ac charging. Hybrid units combine zinc-air and NiCd batteries. The combination allows replaceable zinc-air batteries to recharge the NiCd batteries. Thus, the NiCd battery never needs recharging from ac power. The hybrid battery pack delivers long service life without the inconvenience of ac recharging because zinc-air batteries deliver more than 10 times greater operating life.

Circle (204) on Fast Fact Card



### Paging receiver fits inside Timex wrist watch



Separate controls for timekeeping and pager functions fit a wrist watch pager developed by **Motorola**. Non-volatile memory stores messages even when the pager is turned off. Message time-stamping displays on the LCD screen the time that a message is received. The pager works with common carrier pager systems.

Circle (203) on Fast Fact Card

### Scanning receiver spans four bands, 100 channels

Model AR950 base and mobile scanning receiver covers 27MHz to 54MHz, 108MHz to 174MHz, 406MHz to 512MHz and 830MHz to 950MHz. Twenty-five front-panel keys on the **Ace Communications** scanner allow programming of five banks of 20 channels, or 100 channels altogether.

Circle (205) on Fast Fact Card

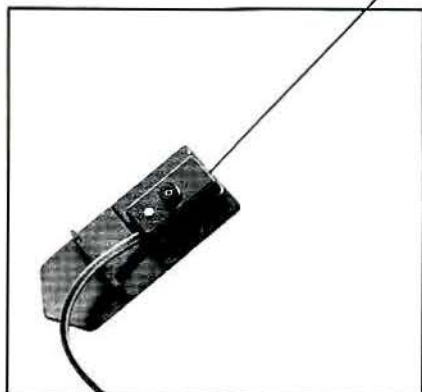




## Portable cellular antenna comes in 2dB, 3dB models

Portable cellular antennas that mount temporarily inside car windows come in 2dB and 3dB models. The Window-Wedge antenna from **Mobile Mark** mounts by sliding its base into the window casing. The cable is connected to the portable or transportable phone. The product is suitable for harsh weather areas where the portable phone user wants clearer reception but does not want to be left with a wet or icy antenna at the end of a trip.

Circle (314) on Fast Fact Card



## Paging entry station works with DAPT paging terminal



Anyone who routinely signals pocket pagers over an in-house paging system can have a quicker and easier method of signaling a pager than by dialing into a PBX telephone. Model 103 paging entry station, manufactured by **Zetron**, has a keypad, LED display and gooseneck mic. When connected to the company's DAPT-Plus paging terminal via a standard telephone cable, it allows an operator to signal a pager by entering a pager number on the keypad and pressing "page."

Circle (328) on Fast Fact Card

## Hand-held transceivers boast wideband operation



Covering 150MHz to 174MHz and 450MHz to 470MHz, HX240 series VHF and UHF hand-held transceivers from **Standard Communications** offer as many as 16 channels with programmable scan. They come in 1.5W and 4W models with built-in CTCSS; top-mounted LCD for channel and mode; rotary channel select; external programming and cloning; and programmable busy channel lockout and time-out timer. DTMF with memory and speed auto-dial is optional.

Circle (338) on Fast Fact Card

## Sales training video targets mobile radio

"The Sales Presentation—Step by Step" is directed at mobile radio sales professionals as a video training aid. The video lists 10 steps to follow in a sales presentation. Available from **The**

**Thornhill Company**, the 22-minute video includes organization and follow-through information.

Circle (253) on Fast Fact Card

# NEW

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## DB564 120° Directional Base Antenna

A 14 dBd gain antenna for all 806-952 MHz applications, the DB564 uses Decibel's patented Center-Fed-Collinear design for steady beam position and good VSWR.

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### Specifications

**Range:** 806-952 MHz

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13.5 ± 1 dBd over

55 MHz

**Front-to-Back Ratio:**

25 dB

**Vertical Beamwidth:**

6°

**Horizontal Beam-**

**width:** 120°

**Electrical Downtilt:**

3°, 6° or 10°

**Length:** 161 inches

Other Decibel models offer 60° to 120° of coverage.

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In addition, the CA-1460 "quick-charges" your portable's battery between uses.

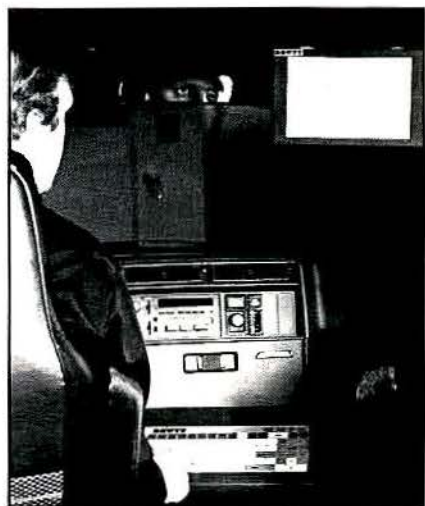
This versatile accessory is housed in a durable Noryl-190® case with an all metal, adjustable pedestal mounting bracket. A mobile microphone is also included. Maxon's CA-1460 . . . there's no better way to go.

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## New products

### Mobile data network offers mapping system compatibility



A mobile data communications system compatible with automated mapping facilities management systems used by utilities is available from **Dowty RFL Industries**. The combination connects a vehicle's drive to all available graphics information at the utility's control station. The information constantly is updated so drives can respond quickly and accurately, especially in an emergency situation, without the inconvenience of maps, drawings and handwritten work orders.

Circle (331) on Fast Fact Card

### Battery analyzer handles 260 types simultaneously

The battery management system from **BatteryPro** maintains as many as 260 batteries at the same time. The RAM-System features solid brass contacts; menu-driven format; programmable functions such as battery voltage, capacity, number of cycles and charge-discharge rates; five charge cutoff techniques; battery backup; and a hold feature that allows battery removal and reinsertion without restarting the cycle. The charger-analyzer unit offers optional barcode reading system, optional down-loading of information to computer database and optional extended warranty. The unit offers real-time logging of battery characteristics such as voltage, current and thermistor resistance for analysis.

Circle (246) on Fast Fact Card



### Portable battery saver plugs into vehicle's lighter



Model MOT800 battery saver from **Ora Electronics** plugs into a vehicle's cigarette lighter for power from the vehicle's battery. The unit fits Motorola 8000/9000 series portable cellular telephones.

Circle (256) on Fast Fact Card

### Trailer-tower unit includes shelter, 100-ft. crank-up model

A 4' x 6' x 6' shelter and a 100-foot crank-up tower combine to form **Aluma Tower's** model TM-51-35-S trailer-tower unit. The trailer-tower can be fitted with any one of the company's 11 crank-up models. The shelter is made of aluminum and foam-core insulation. The unit can be pulled by trailer to a communications site.

Circle (248) on Fast Fact Card

### Desktop charger offers 3½ to 5 hours charging time

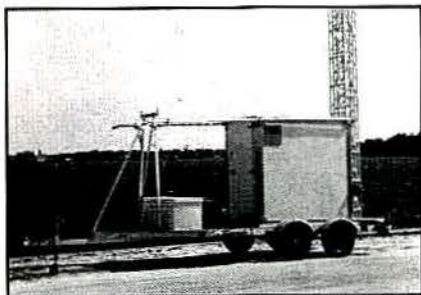
Batteries used in **Kintek Custom Products'** transportable conversion kits can be rapid-charged with the Intellicharger 512. The desktop unit features an LED that indicates state of charge and 3½ to five hours charging time. The unit features automatic shutoff when a battery is charged to capacity.

Circle (244) on Fast Fact Card

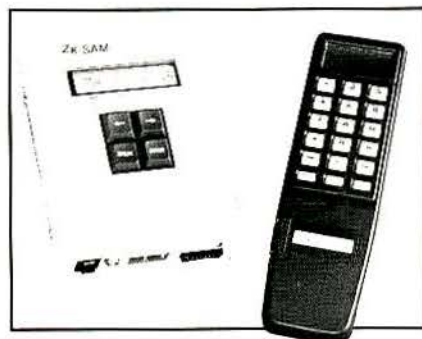
### Telephone interconnect comes in rack-mount version

**Zetron's** model 35A microconnect telephone interconnect unit is available in a rack-mount enclosure. Called the model 35AR, it fits any 19-inch rack.

Circle (329) on Fast Fact Card



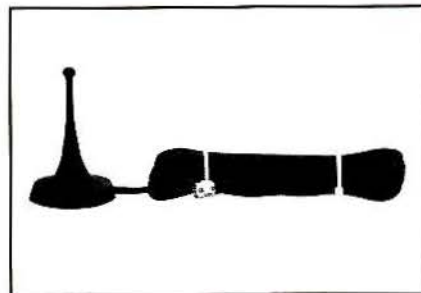
### Cellular system monitor collects call-processing data



The ZK-SAM cellular system monitor from **ZK Celltest** monitors and records cellular phone processing events. As much as six hours of data may be recorded for later playback and printout.

Circle (254) on Fast Fact Card

### Magnet-mount antenna suits trunking, cellular



The CMS585 compact magnet-mount antenna features quarterwave design, wide bandwidth and a heavy-duty magnet. The **Ora Electronics** antenna comes with 12 feet of cable and TNC connector and suits trunking and cellular applications.

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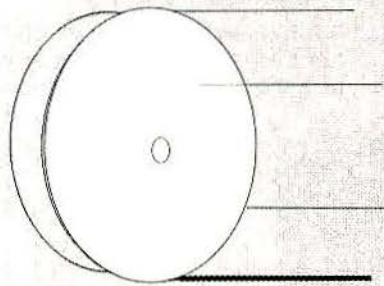
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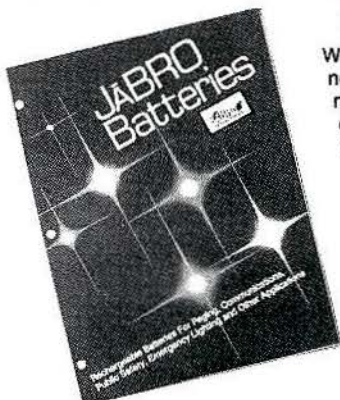
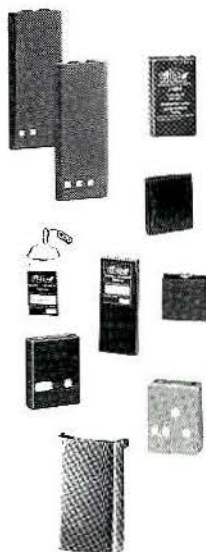
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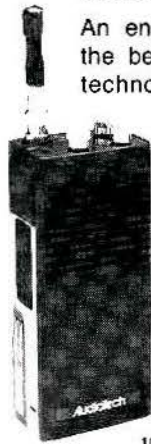
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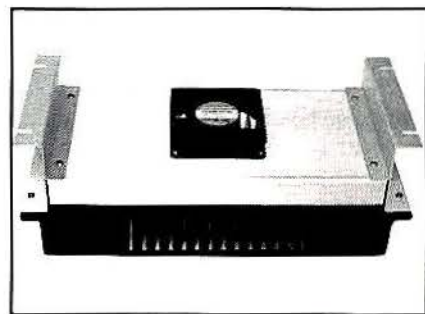
## **New products**

### **Mobile fax interface draws power from radio**

The FaxLink Mk 1 mobile facsimiles interface connects to a two-way radio or cellular telephone via a radio adapter cable that is terminated with an eight-way modular connector. The **Link Systems** unit draws its power from the mobile or cellular telephone. The unit has no internal adjustments.

Circle (281) on Fast Fact Card

### **Cooling fan fits EFJ repeater amplifiers**



A cooling fan for late model E. F. Johnson repeater power amplifiers is available from **Interconnect Specialists**. The fan assembly fastens to the back of the power amplifier heat sink.

Circle (251) on Fast Fact Card

### **Portable plug-in options include digital format**

Plug-in options for Bendix/King portables, including VHF and UHF radios, are available from **Transcrypt International**.

□ Model KR-5260/6260 features FlashCall digital signaling format.

□ Optional FlashCall Plus provides Motorola, GE and Coded digital signaling emulation and FlashCall.

□ Model KR-5460/6460 offers FlashCall and Crypto Voice Plus Level 4 speech encryption.

□ Model KR-5915 offers two-tone decoding and a 10-number autodialer for interconnect.

□ Model KR-5840 5/6-tone option offers encode-decode and is compatible with international tone formats.

□ Model KR-5928 enables users to upgrade VHF portable to 28 channels.

Circle (285) on Fast Fact Card



## Mobile satellite center installs in vehicles



Private vehicular communications are feasible with **Magnavox's** mobile communications center that relies on satellite relay. The operator's station includes a satellite communications terminal, vehicle navigation system, fax, printer, telephone and other communications equipment. A mobile radio link relays

calls from a vehicle to the mobile communications center where the call is patched into a satellite communications terminal and beamed to a satellite. A videotape describing the system and its capabilities is available.

Circle (245) on Fast Fact Card

## Relay expansion cards produce DTMF control



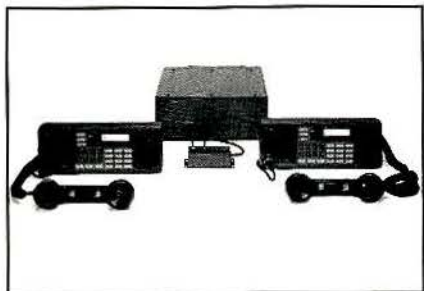
Relay expansion cards produce DTMF-selected remote control functions on the driving microprocessor software, enabling one control function to transform into 64 independent and magnetically latched relay control functions. Made by **Lucas Ledex**, model 2452 cards offer low current drain of 1mA and are field-programmable as a 12Vdc, 24Vdc or 48Vdc system.

Circle (249) on Fast Fact Card

## Fiber optic transceiver includes 150W output

The IC-M800 HF-SSB transceiver from **ICOM** employs fiber optic technology and includes a weather-resistant remote controller. As many as four control heads can be connected to the system controller interface. Features include 150W output, 127 memory channels, noise blanker system and scanning options.

Circle (257) on Fast Fact Card



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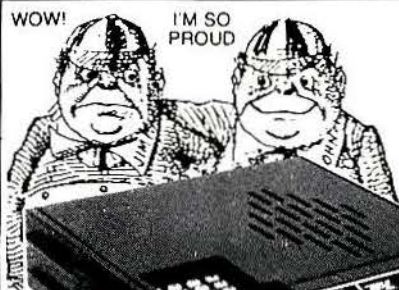
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Circle (60) on Fast Fact Card

## New products

Floor base mount fits  
autos with consoles



To install radio communications equipment in vehicles with consoles and levers, **Gamber-Johnson** offers model DS-57 auto floor base modular mount. The mount is made of heavy gauge steel and provides an adjustable height. DS equipment racks and MDT mount heads will fit onto the floor base.

Circle (247) on Fast Fact Card

Cellular hand-held offers  
99 memory locations



The **NovAtel MicroClassic II** portable cellular telephone features a color keypad, 99 memory locations, alphanumeric speed dialing, electronic lock modes, airtime counters and other user-friendly features. The unit weighs less than 23 ounces.

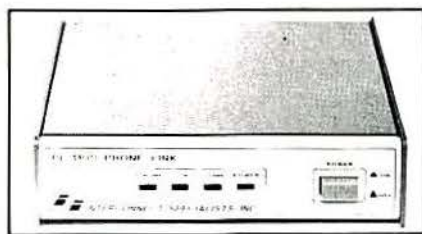
Circle (250) on Fast Fact Card



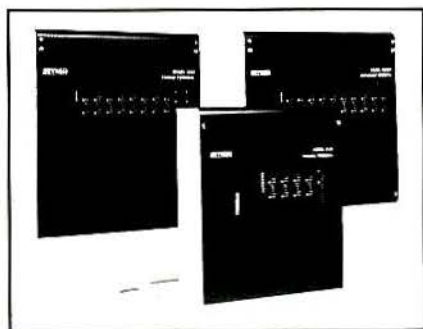
## Phone link transfers simplex into telephone-type operation

The PL-1100 phone link from **Interconnect Specialists** interfaces a standard telephone and simplex transceiver for telephone-type communications over a simplex radio channel. VOX and electronic audio delay are used to eliminate PTT switch.

Circle (273) on Fast Fact Card



## Multiport card accommodates 8 paging terminal interfaces



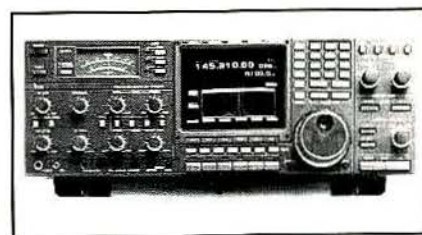
The local serial multiport card from **Zetron** installs in model 2100 and model 2200 paging terminals, providing connections for eight RS-232 entry devices. The card is available with two, four, six or eight ports. It is compatible for alphanumeric input.

Circle (243) on Fast Fact Card

## Receiver sports multifunction CRT display

The IC-R9000 commercial grade receiver from **ICOM** covers 100kHz to 1,999.8MHz. It features a multifunction CRT display; 1,000 memory channels; dual clock and timer; multiple scanning functions; and interference and noise elimination circuit.

Circle (258) on Fast Fact Card



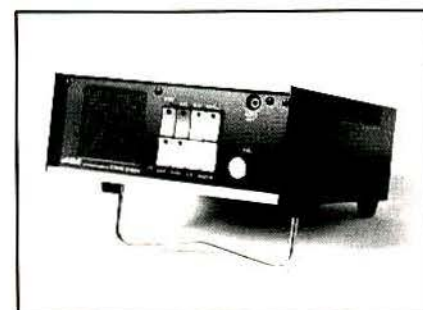
## Vehicular repeater features low current drain, small size

The Xtenda-Comm G3S2 vehicular repeater adapts to most mobile radios and features small size, low current drain, CTCSS encode-decode and control head with function indicator LEDs.

As an RF link, the **Sweet Electronics** unit can replace telephone lines used for base station remote control.

Circle (252) on Fast Fact Card

## Voice recorder offers marking function



The **J.E.I. Comm Check 901** voice recorder features instant recall, simultaneous record and playback, and a marking function that enable an operator to "mark" portions of conversation for quick access. Voice communications are stored on computer memory chips. During recording, the oldest information is replaced with the newest.

Circle (268) on Fast Fact Card

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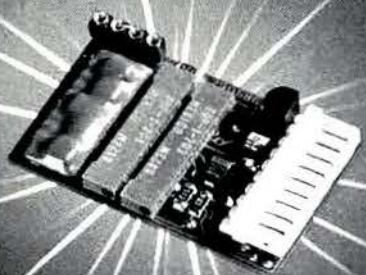


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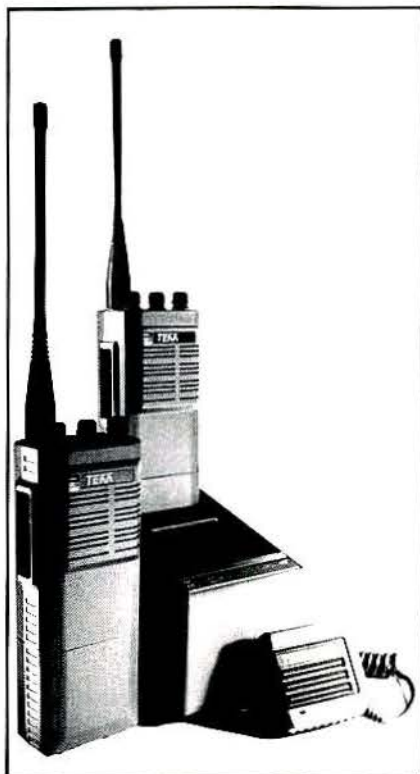


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Circle (62) on Fast Fact Card

## New products

Portable transceivers have diecast aluminum frames



Portable UHF and VHF transceivers from Tekk have diecast aluminum frames, slide-off batteries and high-low power switches. Rated at a maximum 5W RF output, the units cover as many as six channels.

Circle (311) on Fast Fact Card

## THE "ORIGINAL"

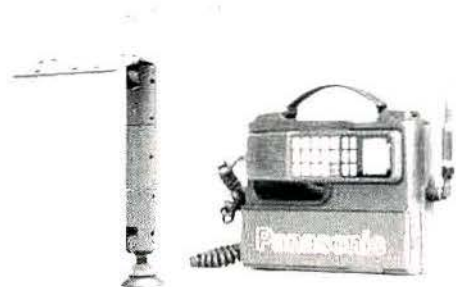
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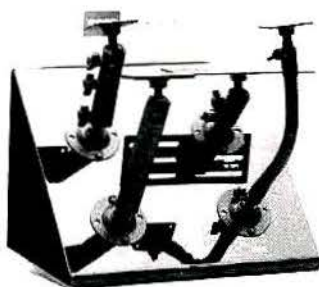
Display samples of SMC's wide variety of installation hardware, including our Portable and Transportable Plates are available. Contact your distributor—or call SMC Electro-Mount for additional information on our complete line of Plate options and Point-of-Purchase Displays.



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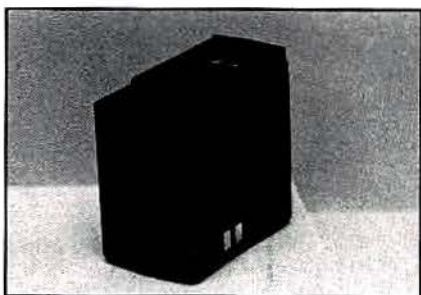
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Circle (63) on Fast Fact Card

NiCd pack replaces Yaesu battery models



Model MFNB-17 battery from Multiplier replaces Yaesu FT, FTC and FTH model radios. The NiCd battery is rated at 600mAh with nominal open circuit voltage of 7.2V.

Circle (287) on Fast Fact Card



## Adapter kit suits coaxial connections

Model 5698 universal adapter kit allows user-selectable adapter combinations such as SMA to BNC and BNC to double banana plugs for connecting coax to instruments. The **Pomona Electronics** adapters feature gold-plated center pins and silver-plated bodies. The kit includes two of the following: BNC male, BNC female, TNC male, TNC female, SMA male, SMA female, N male and N female. Also included are four intermediate coupling nuts; one double banana plug; and one double banana



jack-binding post combination.

Circle (274) on Fast Fact Card

## Base station controllers for analog, digital paging

Remote base station controllers from **CTI** support analog and digital paging formats via onboard 1,200baud modems for digital data conversion and recovery. Model TXC-100 forms the transmit end of the package, and model TXC-200 serves as the receiver.

Circle (275) on Fast Fact Card

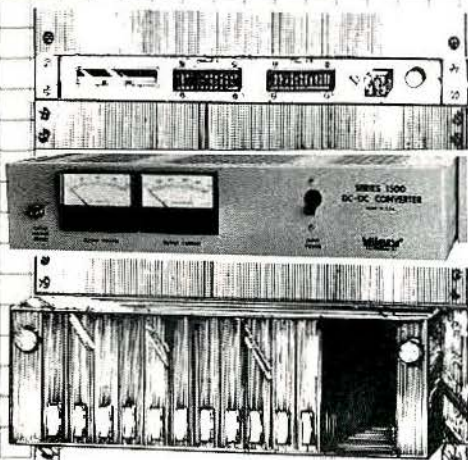
## Desktop unit recharges batteries in 5 hours

The **Intellicharger 500** holds one battery at a time and recharges a unit in five hours. The **Kintek Custom Products** desktop charger features two-color LED display for state-of-charge indicator and automatic shutoff. It charges 1A and 1.8A batteries.

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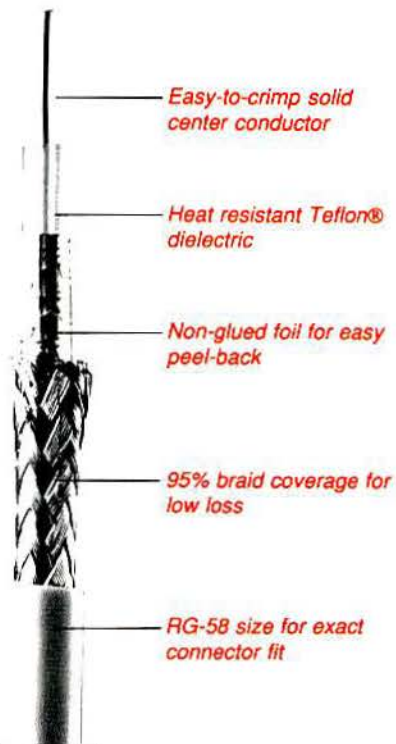
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## New products

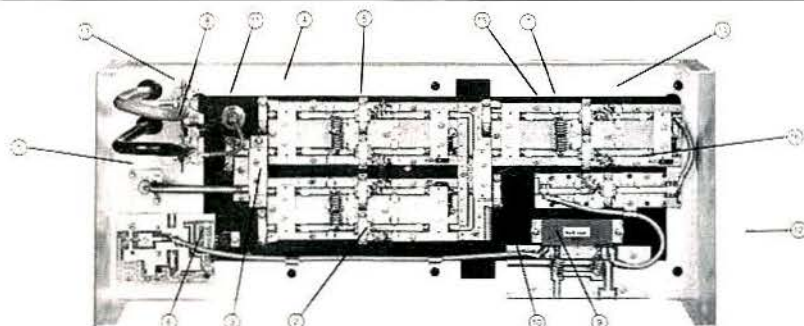
Trunked hand-held  
offers 14 systems



The 8570 900MHz hand-held from **E. F. Johnson** features 14 systems and as many as 10 groups per system. The trunked portable has system and group scan, LCD and conventional 900MHz channel operation with repeater talkaround. Version 8571 is intrinsically safe.

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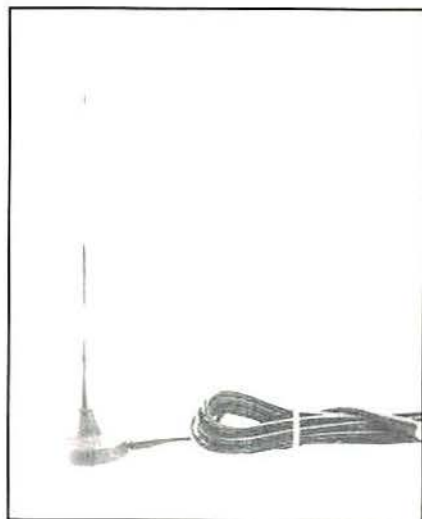
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Magnet-mount antenna  
boasts 3dB gain, portability



Model CMS586 3dB magnet-mount cellular antenna installs temporary on roofs and boasts a small size for transportability. The **Ora Electronics** antenna comes with 12 feet of attached RG58/U coaxial cable and TNC connector.

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- Externally adjustable audio and DTMF levels for easy installation.
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#### THE PROGRAMMABLE CHOICE

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## New products

### ANI software upgrades Touch-Tone encoders

ANI software features are available on **Pipo Communications'** Touch-Tone encoders. Two software versions are available: ANI 1.0 and ANI 2.0. The versions include speed, pause and PTT adjustments.

Circle (279) on Fast Fact Card

### Microcomputer fits vehicular applications



The VCP-286 laptop microcomputer suits vehicular operating conditions and is available from **ZeBryk Engineering**. It operates at 12MHz and comes with 1MB of RAM, two serial ports and a parallel port. The computer features a standard PC/AT layout with a 100-key keyboard. The unit operates on 12Vdc vehicular electrical systems and is protected against alternator load dumps, starting sags, voltage surges, battery jumps and charging.

Circle (283) on Fast Fact Card

### Paging system software supports deaf communication

Alpha message input from Telecommunications Device for the Deaf (TDD) is available with software developed by **Unipage** for its paging systems. The TDD device allows hearing impaired individuals to communicate via telephone with messages typed on the TDD keyboard and read from the TDD display. The Unipage TDD message support product enables messages to be sent to an alphanumeric pager from the TDD keyboard.

Circle (286) on Fast Fact Card

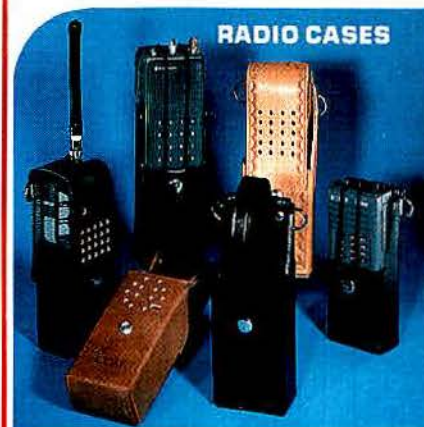
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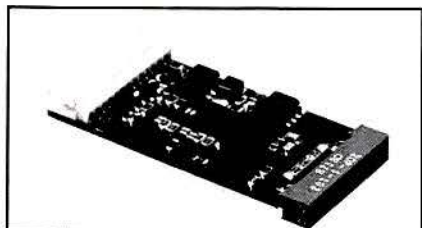
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## New products

### Two-tone decoder sports 2-minute Tx limit timer



Model ST-205 two-tone sequential decoder from **Selectone** installs in most miniature hand-helds for talk-back paging applications. It is compatible with Motorola Quick Call II and GE type 99 signaling formats. It has two latched outputs and includes a two-minute transmit limit timer with alert tone. An en-

hanced version, model ST-205P features an extended operating frequency range and is compatible with all two-tone sequential paging formats. Both modules are field-programmable.

Circle (271) on Fast Fact Card

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Circle (70) on Fast Fact Card

### NEW COMET Super Linear Dual Band Antennas

CA-2x4ZC  
BASE/REPEATER



150-160 MHz  
460-480 MHz  
Gain: 8.2/11.5dB  
Max Power: 200W  
Fiberglass

Wind Load  
98 ft. per second

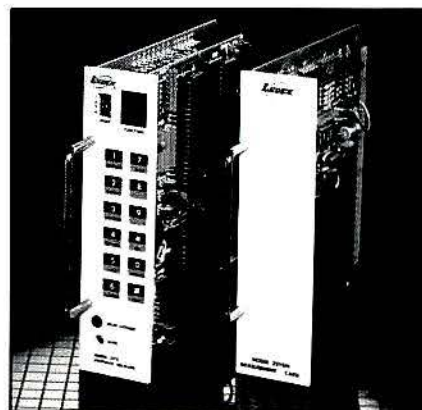
Simulcast  
with CF-416  
Duplexer



1275 N. Grove St.  
Anaheim, CA 92806  
(714) 630-4541  
FAX (714) 630-7024

Circle (71) on Fast Fact Card

### Automated system checks remote circuits

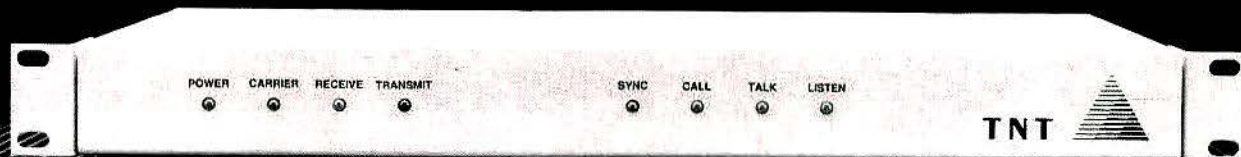


The Netcheck automated system remotely tests communications circuits. Made by **Lucas Ledex**, the system detects and quantifies excessive loss in both inbound and outbound paths, plus high noise levels. The system uses a model 2212 loopback card with a "sandwich" measurement board at all remotes and a personal computer with interface card and software at the master site. The combination automatically polls and tests two-wire and four-wire telephone lines and microwave communications networks and records the results.

Circle (319) on Fast Fact Card

## Adding a Trunk Channel?

TNT-100 LTR® Logic and Interconnect



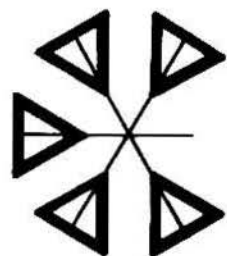
**Trident Micro Systems**

10221 Slater Ave., Suite 103, Fountain Valley, CA 92708 (800) 798-7881 or (714) 549-6208

Circle (72) on Fast Fact Card

Add or replace existing channels logic and interconnect. Fully compatible with Johnson and Uniden trunking systems. Works with CTCSS and all LTR® compatible radios. Full function interconnect with voice prompting. Networking using existing telephone lines.



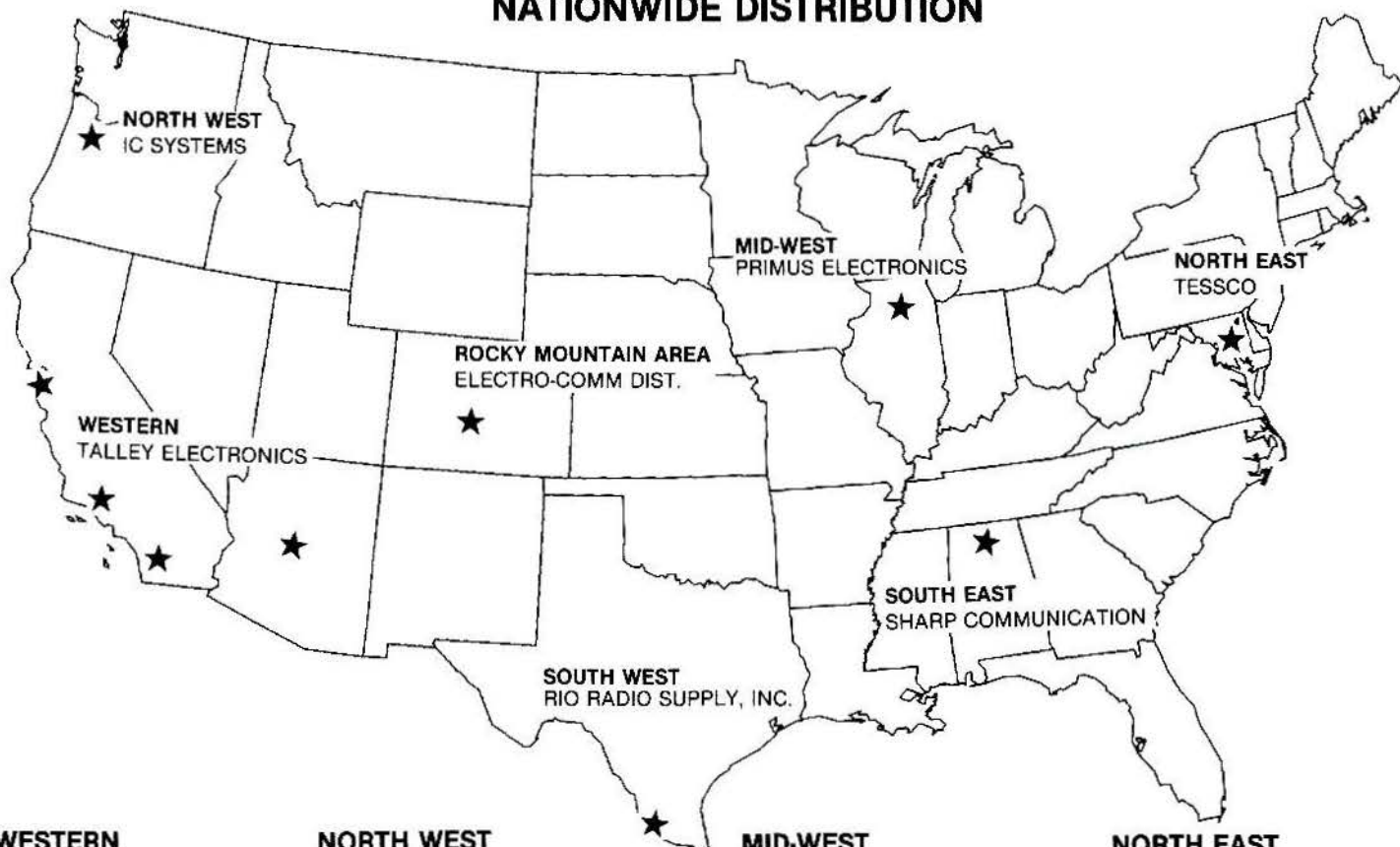


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FAX: 800/767-7605  
FAX: 815/436-8954

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FAX: 512/682-9114

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FAX: 301/584-7450

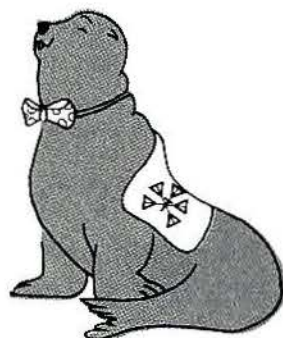
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**Antennas**

Circle (73) on Fast Fact Card



## Puts All The Best At Your Finger Tips



## New products

### Low profile antennas fit cellular portables

Model CMS400 and model CMS401 low profile antennas measure less than 1 inch in height and fit cellular portables. The CMS400 fits Motorola's 8000/9000 series portables and features SMA female connector. **Ora Electronics'** CMS401 features a TNC male attachment for use with TNC-equipped portable cellular phones.

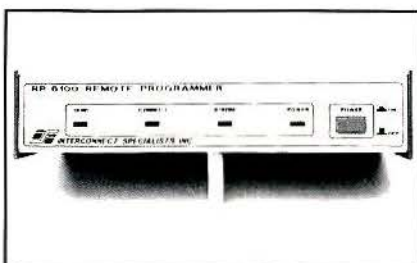
Circle (276) on Fast Fact Card

### Microwave radio link functions with paging device

The SAM AlphaBox bolsters tone and numeric paging terminals functions with alphanumeric capability. An enhancement to the AlphaBox, a full duplex microwave radio link, is available from **TekNow** and **Celltronics**. The AlphaBox enhancement includes Celltronics' RS-232 full duplex 900MHz radio control links, which are mounted between the AlphaBox and the paging terminal.

Circle (270) on Fast Fact Card

### Remote programmer enables EFJ LTR code validation



The RP-6100 remote programmer from **Interconnect Specialists** allows remote programming of the E. F. Johnson code validator. Programming can be performed from any DTMF telephone or DTMF-equipped transmitter. The unit comes with cable to interface with Johnson LTR code validator.

Circle (272) on Fast Fact Card

### Cellular modem works in 12Vdc vehicles

The VCM-12000 Class 10 cellular modem from **ZeBryk Engineering** connects to most cellular telephones for automated call origination and answer-

ing. The VCM is housed in a sealed, aluminum enclosure. The product operates off 12Vdc vehicular electrical systems.

Circle (282) on Fast Fact Card

### DTMF encoder has 'steel key' buttons

A DTMF encoder is available with steel keys and sealed, gold dome contacts from **Pipo Communications**. Models include PK-1, PK-1 with relay,

PK-2 and PK-2 with relay. The units boast a simple three-wire connection and wide operating range of 8.5Vdc to 16Vdc.

Circle (278) on Fast Fact Card



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Circle (84) on Fast Fact Card



## Directory explains details of antenna sites

**Intrafamily Communications'** National Communications Site Directory lists towers; buildings; water tanks; power and shelter availability; antenna positions; coverage area; and lease terms of communications sites.

Circle (498) on Fast Fact Card

## Handbook covers microwave operations

**RSGB Microwave Handbook Volume 1** covers operating techniques; system analysis and propagation; microwave antennas; transmission lines and components; and microwave semiconductors and valves. The 224-page handbook is offered by the **American Radio Relay League**.

Circle (232) on Fast Fact Card

## Catalog details cadmium battery power packs

A 12-page catalog from **Tadiran** details its rechargeable sealed NiCd battery power packs and subassemblies. Tadiran power packs are rated 12V, with high-power 13.2V versions available in select models. Increased capacity subassemblies and custom-made packs with chargers are available.

Circle (235) on Fast Fact Card

## Brochure describes radio transceivers

**Harris** long-range radio division's brochure describes its RF-3200 series HF/SSB radio transceivers. The RF-3200 has an automatic antenna coupler; software-controlled operating procedures; and advanced speech processing techniques.

Circle (233) on Fast Fact Card

## Data includes cellular batteries, accessories

**Multiplier's** "Cellular Products Catalog" describes its portable cellular telephone batteries and accessories, including standard and high-capacity batteries, travel battery eliminators, transportable battery systems and chargers.

Circle (496) on Fast Fact Card

## Pamphlet examines effects of noise

A six-page monograph on the effects of noise on a communications system is available from **Western Multiplex**. It explains noise; noise weighting; noise figure and noise temperature; phase; and FM noise.

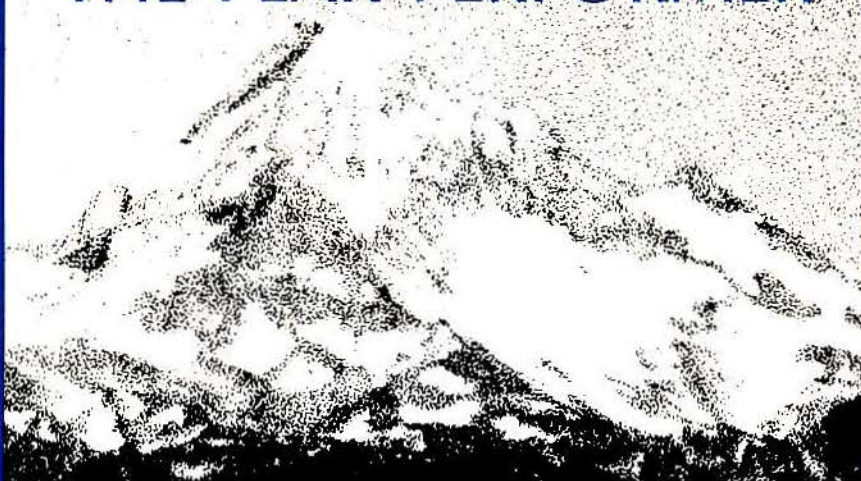
Circle (239) on Fast Fact Card

## Bulletin explains elliptical waveguide

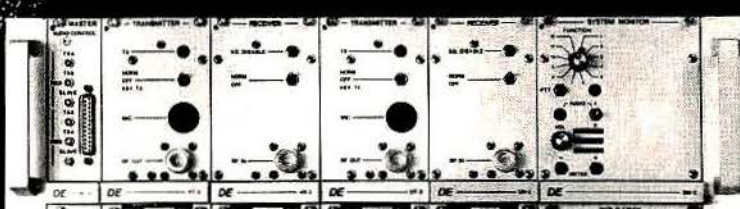
Electrical and mechanical specifications of the Flexwell elliptical waveguide, types WE46 and WEP46, are provided in a bulletin from **Cable-wave Systems**. Installation accessories are explained.

Circle (266) on Fast Fact Card

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Circle (76) on Fast Fact Card



## Literature

### Book provides data on tower, site management

**Pirot's** tower specification guide helps buyers evaluate and select guyed and self-supporting towers. It provides tower specification criteria, environmental considerations and design options.

Circle (494) on Fast Fact Card

### Brochure details cleaning pads and swabs

Cleaning pads and foam swabs are detailed in **Texwipe's** presaturated products brochure. The pads are self-contained products with an applicator and solvent in each packet.

Circle (238) on Fast Fact Card

### Directory details aeronautical frequencies

The Official Aeronautical Frequency Directory lists the HF, VHF, UHF and 800MHz-to-950MHz frequency ranges. General system information, FCC allocations charts, and trunked 800MHz systems used for portable and mobile communications at airports are listed in the 416-page publication by **Official Scanner Guide**.

Circle (242) on Fast Fact Card

### Catalog explains battery specifications

Specifications and application data on **Power-Sonic's** rechargeable sealed lead-acid batteries are available. A 20-page publication includes discharge characteristics; performance data; charging instructions and tips on design and proper care.

Circle (237) on Fast Fact Card

### Government report reviews mobile antennas

The National Institute of Justice (NIJ) summarizes performance requirements and test methods for mobile antennas in its latest publication: "Mobile Antennas, NIJ Standard—0205.01."

Circle (213) on Fast Fact Card

### Brochure lists replacement battery

**PowerPak's** replacement battery brochure includes specifications and cross reference material for sealed lead acid, lithium, NiCd, cordless telephone and computer batteries.

Circle (231) on Fast Fact Card

### Catalog describes microwave components

More than 300 microwave components, instruments and systems in the dc to 110GHz range are found in **Wintron's** catalog. General information precedes each major product group, assisting the reader in locating and selecting the best solution to a measurement problem.

Circle (240) on Fast Fact Card

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# If You Think All Phone Patches Are The Same, TAKE A CLOSER LOOK

- **Zetron Exclusive:** "DIGIT LOCK" for extended DTMF decoding range.
- **RS-232 Port:** lets system operator print out call detail information and easily program phone patch.
- **Internal 300/1200 Baud Modem:** allows remote programming on same phone line that is used by patch. Also allows factory service personnel to aid in servicing unit.
- **Upload/Download Capability:** allows system operator to safely store system programming information.
- **Multiple Phone Line Capability (2 to 16 lines):** allows customers to have their own dedicated phone line.
- **Voice Prompts:** instruct phone callers on how to use the system.
- **Selectable Pulse or Regenerated Dialing to Phone System**
- **Rings and Progress Tones:** with correct timing and sounds.
- **Privacy Mode:** allows mobile to talk to phone party without being monitored by other users on system.
- **Automatic Error Checking:** when transferring data to or from patch.
- **Internal Memory Buffer:** stores call detail information.
- **Unattended Auto Call Function:** allows page to be automatically sent when a special phone line is called.
- **Second Dial-Tone Disconnect:** prohibits toll restriction from being easily defeated.
- **Toll Restrictions & Calling Privileges:** on a per user basis.
- **Flexible Timers & Parameters:** allow the system to be fine tuned.
- **Superior Sounding Audio:** that will impress your customers.
- **Flexible Connect & Disconnect Sequences:** which can include variable length ANIs or fast ANI.
- **Simplex VOX, Digital Delay, and Sampling:** for optimum simplex capability.
- **CTCSS and DCS Signaling:** for duration of call or only during selective signaling or until mobile answers.
- **Multiple Call Limit Timers:** can be assigned on a per user basis.
- **Built-in Community Repeater Panel.**

*Some features listed are optional. Consult factory for configuration information.*

Zetron's Model 45 Z-PATCH Telephone Interconnect and Model 48 Repeater Manager



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## Feedback

### Buyers' Guide serves as a purchasing reference

The most common use for the Buyers' Guide is as a purchasing reference, according to 76.8% of the respondents to the December 1989 "What Do You Think?" questionnaire. Other uses are reported in these statistics (Multiple responses add up to more than 100%):

USE OF GUIDE	%
File for purchasing reference	76.8%
To receive manufacturers' literature	70.5%
To contact vendors	63.2%
Other	9.5%
Do not plan to use	2.1%
No response	0%

The majority of the respondents, 55.8%, retain the Buyers' Guide 12 months or longer. Only 2.1% keep the buying source for one to two months; 11.6% save the guide two to six months; and 28.4% use the guide six to 12 months.

Most of the respondents spend 30 minutes to an hour reading the guide the first time through before saving it for future reference. Some readers peruse the guide two or more hours, and 32.6% re-

port they read it one to two hours the first time.

Pass-along copies of the guide are popular, as reported by respondents. The issue is routed to engineering departments, supervisors, buyers, technicians and support staffs.

Comments on the guide include: "It is a handy reference to suppliers." "The guide and MRT are always useful and have valuable information on products and services."

"I like all of the companies that advertised in this issue." "It puts everything at my fingertips."

**Be sure to fill out this month's "What Do You Think?" questionnaire on page 105 so your responses can be included in a future "Feedback" column.**



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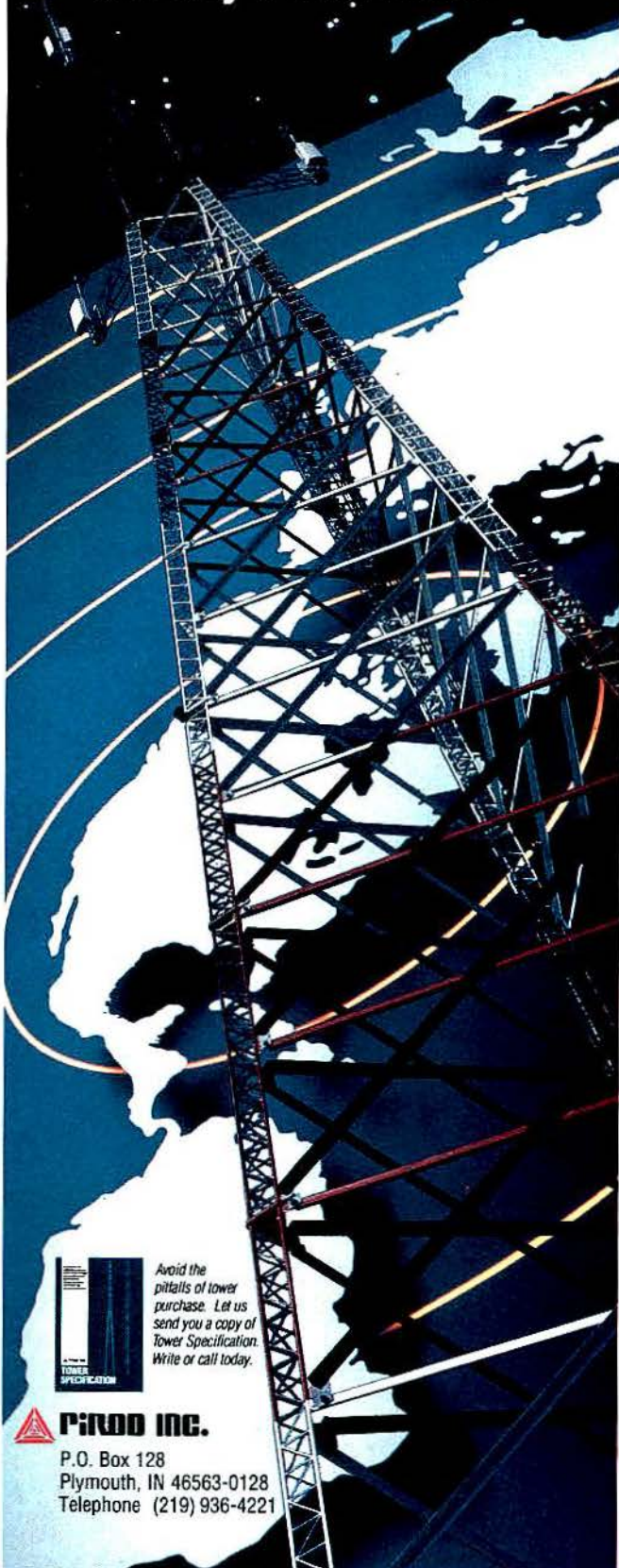
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## **P**eople



Thompson



Scott



Baker



Singer

**Dean Thompson**, engineering project leader with Bendix/King, Lawrence, KS, advances to product manager. **Corbett L. Scott** leaves Aerotron, Raleigh, NC, as manager of contract administration, bids and proposals to join Bendix/King as major account manager, developing federal government markets in Washington, DC.

**William M. Baker** departs the Greater Buffalo Opera, Buffalo, NY, as marketing director to become director of marketing and sales for Sti-Co, Buffalo.

**Andrew Singer** exits Channel Master as antenna design engineer to become senior application engineer with Sinclair, Tonawanda, NY.

**Klaus Bender**, senior radio engineer with Digital Radio Networks, Vienna, VA, joins the Special Industrial Radio Service Association (SIRSA), Arlington, VA, as manager of engineering services.

**James M. Dellapa** leaves Booz Allen and Hamilton Advanced Technology, Washington, DC, to join Dixon Communications Associates, Washington, DC, as an associate.

Changes at Englewood, CO-based U S West: **John E. DeFeo**, president of U S West NewVector, advances to president of a new U S West Diversified division that covers domestic and international radio communications.

**Reynie Ortiz**, president of U S West International, replaces DeFeo as president of U S West NewVector. **Stevens E. Andrews**, NewVector vice president of operations and engineering, advances to president of U S West International, succeeding Ortiz.

**Walker L. Fleming III**, director of new product development for U S West Communications' Home and Personal Services, Phoenix, advances to president of the company's Public Safety Group in Dublin, CA.

Additions to Unipage, DeSoto, TX: **John Rosta** joins the company as software engineer. **Tony Battaglia** is operations manager. **Hoi Meinzer** is manager of special accounts. **Ron Walton** becomes marketing services manager, bringing more than 20 years of experience to the position.

**Eric Wright** leaves a manufacturers rep firm to join SCA, Oklahoma City, as head of its customer service division.

**Denise Lund** joins Shaffer Communications Group, Houston, as resident architect.





## July

15-18—Forestry-Conservation Communications Association, Little America Hotel, Flagstaff, AZ. Contact: Don Pfohl, 602-644-3166.

## August

18-22—International Association of Fire Chiefs Annual Meeting, Peabody Hotel, Orlando, FL. Contact: 202-833-3420.

26-30—Associated Public-Safety Communications Officers 56th Annual National Conference, Boston Sheraton Hotel, Boston. Contact: 800-824-1850.

## September

26-28—Mobilecomm Expo & Cellular Showcase, Orange County Convention Center/Civic Center, Orlando, FL. Contact: 303-220-0600.

## October

6-11—International Association of Chiefs of Police Annual Meeting, Tulsa Convention Center, Tulsa, OK. Contact: 703-243-6500.

9-12—Telocator 42nd Annual Convention & Exposition, McCormick Place, Chicago. Contact: 800-422-4862.

22-23—American SMR Network Association's SMR Business and Finance Conference, Copley Plaza Hotel, Boston. Contact: 202-331-7773.

25-27—Special Industrial Radio Service Association Annual Meeting, Hotel del Coronado, Coronado, CA. Contact: Barbara J. Levermann, 703-528-5115.

## November

1-2—Energy Telecommunications and Electrical Association Annual Fall Seminar on "Networking LANs, MANs and WANs," Stouffer's Greenway Plaza, Houston. Contact: 214-235-0655.

8-11—Communications Marketing Conference, Denver. Contact: John Ehret, TPL Communications, 213-256-3000.

16—Radio Club of America Annual Meeting and Awards Banquet, New York Athletic Club, New York. Contact: 201-246-7271.

## 1991

### January

14-16—Cellular Telecommunications Industry Association 1992 Winter Meeting and Exposition, San Diego. Contact: 202-785-0081.

### February

25-26—American SMR Network Association 1991 New Technologies Symposium and SMR Expo, Westcourt in the Buttes, Phoenix. Contact: 202-331-7773.

### March

3-6—Energy Telecommunications and Electrical Association '91, George R. Brown Convention Center and Hyatt Regency, Houston. Contact: 214-235-0655.

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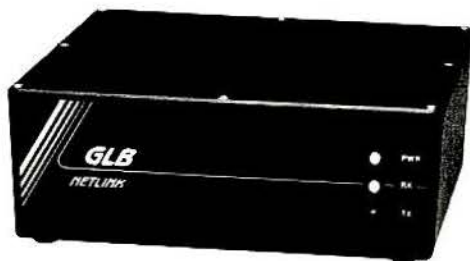
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Circle (85) on Fast Fact Card

# NEW FROM GLB

## GLB NETLINK 450 High-Speed Data Transceiver

The NETLINK 450 is a digital-in, digital-out FSK data radio designed for high-speed packet linking, featuring 450-470 mhz simplex operation, 2 watts of output and a data rate of up to 9600 baud in a standard 15 KHz voice channel. It is a superior alternative to the adaptation of voice equipment. The turnaround time is a fast 1 millisecond, making it possible to use simplex operation at high data rates without significant loss of throughput. A digital sampling AFC tracks transmitted signals in frequency to maintain low error rates over long periods of time.



### FEATURES:

- \*Conservative design
- \*Rugged construction
- \*Data-transparent operation
- \*Digital sampling AFC
- \*Ultimate BER better than 10<sup>-6</sup>
- \*1 ms turnaround time
- \*5 Helical resonator front end
- \*High power version available
- \*Oven-controlled oscillators
- \*Status LEDs
- \*PIN diode antenna switching
- \*Transmitter timeout timer
- \*12 VDC operation
- \*Compact size
- \*FCC Type Accepted

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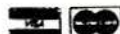
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You will be responsible for leading and guiding engineering development and implementation functions for land mobile and special services.

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## PAGING SERVICE DEVELOPMENT ENGINEER

You will lead the engineering aspects of the design, development and introduction of the satellite paging service, and provide technical support to member countries, equipment manufacturers and service providers.

You must have 5+ years' experience in systems design, development and implementation of terrestrial radio-paging and/or cellular radio systems, and a working knowledge of paging standards such as POCSAG, network management of paging systems, and relevant CCIR/CCITT work. **Ref: 4278/MS.**

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You will be responsible for developing procedures and managing operational interfaces with service

providers and routing organizations for commissionings of land mobile terminals which ensure the integrity of the network while providing easy access to the systems.

You must have 5+ years' experience of telecommunications (preferably cellular) customer service engineering and be familiar with billing and accounting practices for public mobile radio systems, and with developments in modern mobile communications networks. Knowledge of CCIR/CCITT work and the operations of radio regulatory authorities relevant to mobile communications is important. **Ref: 4279/MS.**

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You will provide engineering support for the development and introduction of new land mobile systems/services through systems performance characterization with analytical and simulation tools, and new applications development.

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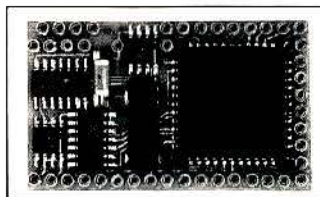
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Same features  
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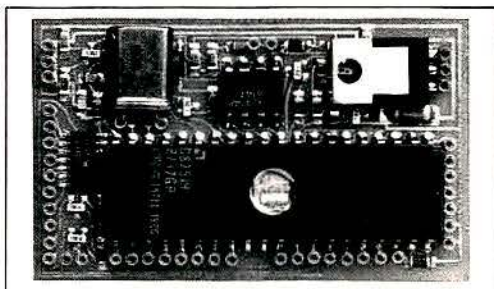
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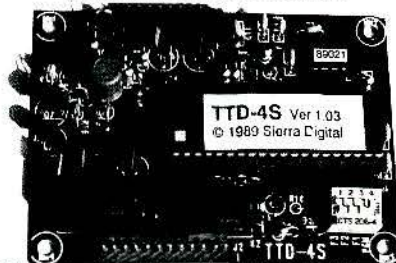
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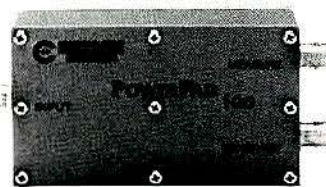


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- 100 MICOR, 155 MHz, T73RTN3000
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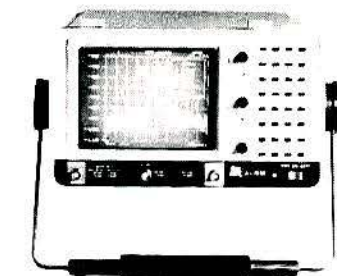
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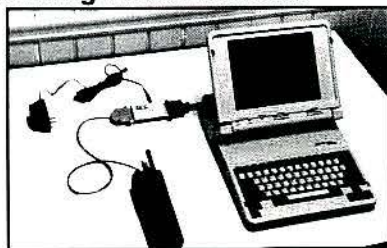
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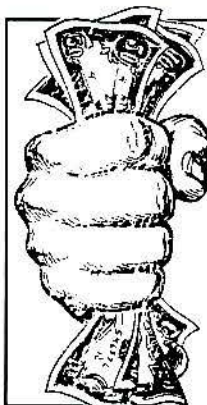
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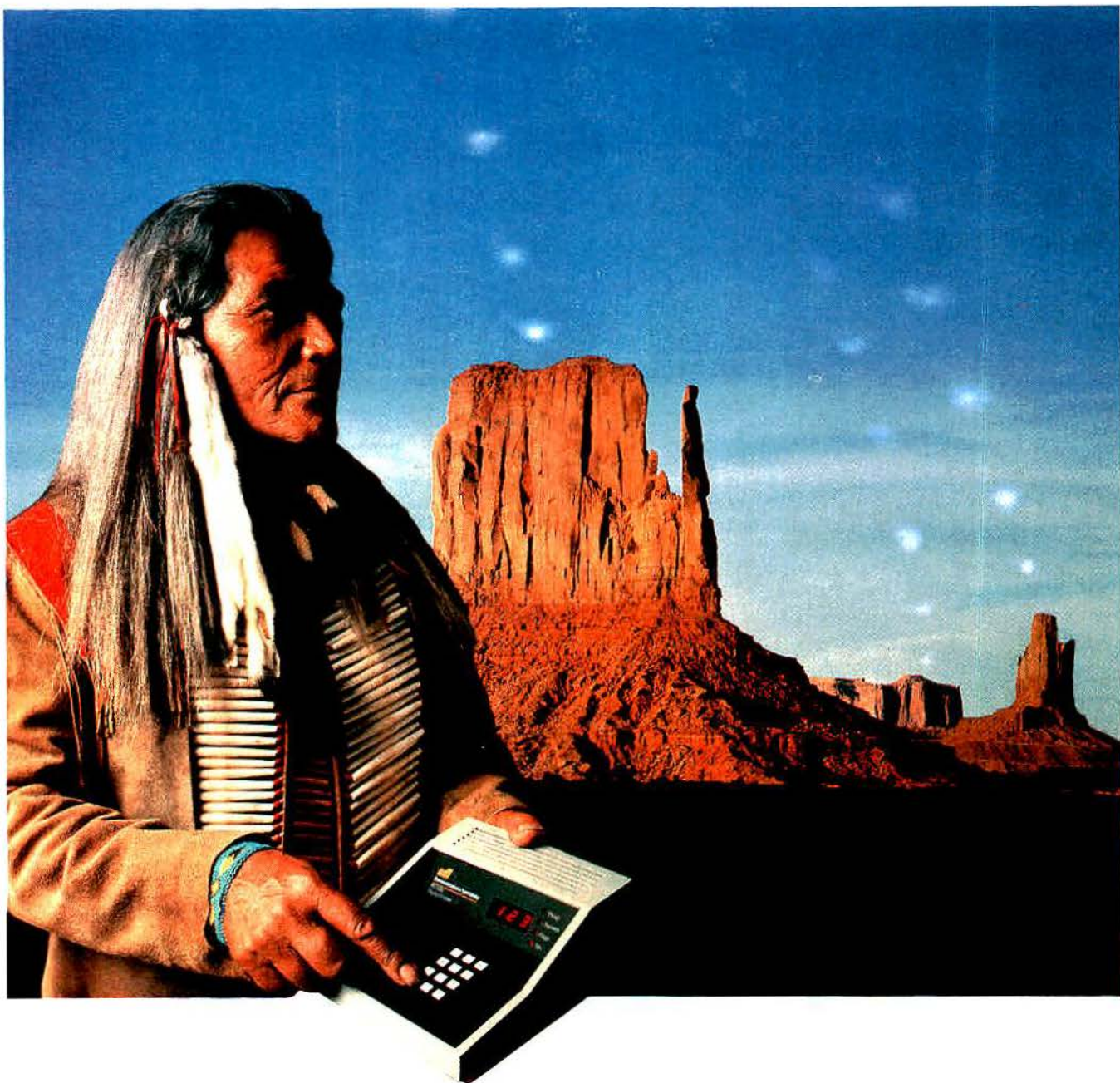
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